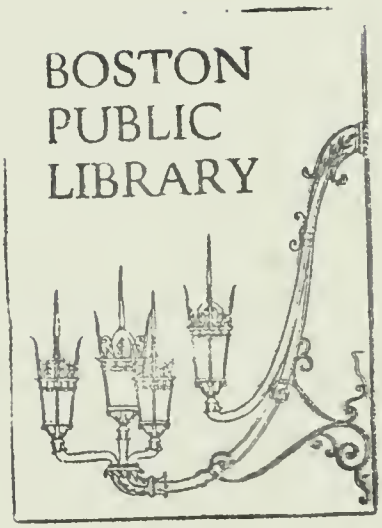
GOVDOC
BRA
540


BOSTON
PUBLIC
LIBRARY

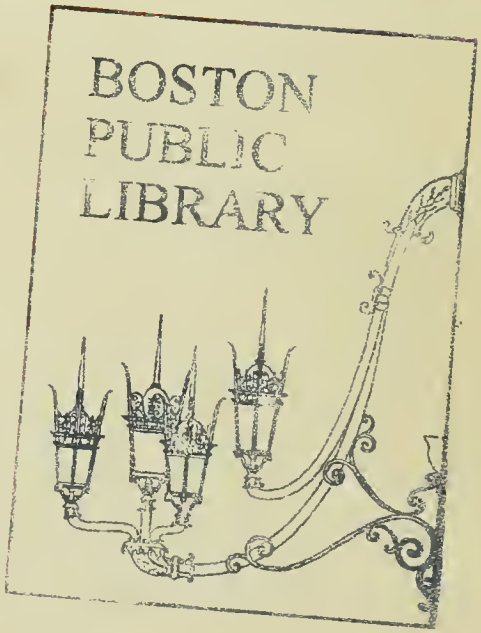
gov. 96-1384

BRA
314

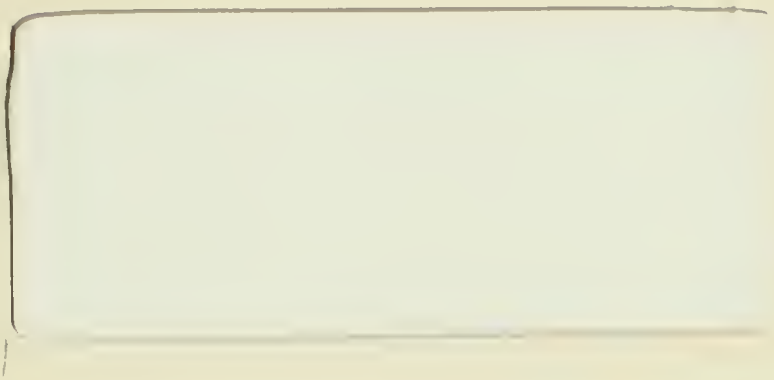
NAVY

CHARLESTOWN

BOSTO



EDWARDS and KELCEY



BRA
740

gov. 16 1990

TRANSPORTATION IMPACT ANALYSIS

Master Plan

NAVY
CHARLESTOWN
YARD

Prepared for the
Boston Redevelopment Authority

Prepared by
TAMS Consultants, Inc.

February 1990

TRANSPORTATION IMPACT ANALYSIS

CHARLESTOWN NAVY YARD

MASTER PLAN

Prepared for the

Boston Redevelopment Authority

Prepared by

TAMS Consultants, Inc.

February 1990

TABLE OF CONTENTS

		Page
I.	INTRODUCTION	1
II.	SUMMARY OF FINDINGS AND CONCLUSIONS	1
	A. Master Plan Phase I	1
	B. Supplemental Transportation Improvements	4
	C. Master Plan Phase II	4
III.	BACKGROUND AND DEVELOPMENT ASSUMPTIONS	5
	A. Previous Studies	5
	B. Study Area	8
	C. Development Assumptions	8
IV.	IMPACT ANALYSIS METHODOLOGY	10
	A. Background Traffic Conditions	11
	B. Navy Yard Trip Generation Methodology	11
	C. Navy Yard Traffic Distribution and Assignment	22
	D. Traffic Analysis	22
V.	TRAFFIC ANALYSIS FINDINGS	23
	A. City Square Intersection	23
	B. Chelsea Street Intersections	28
VI.	CIRCULATION IMPROVEMENTS	35
	A. Internal Circulation	35
	B. Medford Street Bypass	39
	C. New England Aquarium Bus Access and Storage	41
VII.	PARKING REQUIREMENTS	41
	A. Existing Parking Demand	41
	B. Master Plan Phase I Parking Demand	43
	C. 1995 Parking Supply	46
VIII.	PUBLIC TRANSPORTATION	48
IX.	PHASE II DEVELOPMENT	49
	A. Trip Generation	51
	B. Traffic Analysis	53
	C. Master Plan Phase II Year 2000 Parking Analysis	59

LIST OF TABLES

		Page
Table 1:	Charlestown Navy Yard Total Development	10
Table 2:	1989 Calibrated Daily Trip Generation Rates	13
Table 3:	April 1989 Total Vehicle Trips, Existing Conditions	14
Table 4:	Comparison of Daily Trip Generation Rates, Charlestown Navy Yard	16-18
Table 5:	April 1995 Total Vehicle Trips, Phase I Master Plan	20
Table 6:	April 1995 Total Vehicle Trips, May 1988 Master Plan	20
Table 7:	August 1995 Total Vehicle Trips, Phase I Master Plan	21
Table 8:	August 1995 Total Vehicle Trips, May 1988 Master Plan	21
Table 9:	Distribution of Navy Yard Auto Trips	22
Table 10:	Level of Service Criteria for Signalized Intersections	23
Table 11:	City Square Signalized Intersection Analysis 1995	24
Table 12:	Chelsea Street Signalized Intersection Analysis 1995, Widened Gate #5	31
Table 13:	Chelsea Street Signalized Intersection Analysis 1995, New Gate #6	35
Table 14:	Master Plan Phase I Development -- Average Weekday Parking Demand, April 1995	45
Table 15:	Master Plan Phase I Development -- Peak Summer Weekday Parking Demand, August 1995	45
Table 16:	Master Plan Phase I Development -- Peak Summer Saturday Parking Demand, August 1995	46
Table 17:	1995 Parking Conditions at Peak Accumulation, Master Plan Phase I	47
Table 18:	April 2000 Total Vehicle Trips, Phase II Master Plan	52
Table 19:	August 2000 Total Vehicle Trips, Phase II Master Plan	52
Table 20:	City Square Signalized Intersection Analysis Year 2000	53

List of Tables, cont. Page

Table 21: Chelsea Street Signalized Intersection Analysis Year 2000, Widened Gate #5 56

Table 22: Chelsea Street Signalized Intersection Analysis Year 2000, New Gate #6 56

Table 23: Master Plan Phase II -- Average Weekday Parking Demand, April 2000 59

Table 24: Master Plan Phase II -- Peak Summer Weekday Parking Demand, August 2000 60

Table 25: Master Plan Phase II -- Peak Summer Saturday Demand, August 2000 60

Table 26: 2000 Parking Conditions at Peak Accumulation, Master Plan Phase II 61

LIST OF FIGURES

		Page
Figure 1:	Charlestown Navy Yard Traffic Access	7
Figure 2:	Charlestown Navy Yard Development	9
Figure 3:	City Square Intersection Improvements	25
Figure 4:	1995 AM Peak Hour Build Volumes, Widened Gate #5	26
Figure 5:	1995 PM Peak Hour Build Volumes, Widened Gate #5	27
Figure 6:	Gate #5 Widening and Realignment Conceptual Plan	29
Figure 7:	Gate #5 Option 2: Widening Only Conceptual Plan	30
Figure 8:	Gate #6 Conceptual Plan	32
Figure 9:	1995 AM Peak Hour Build Volumes, New Gate #6	33
Figure 10:	1995 PM Peak Hour Build Volumes, New Gate #6	34
Figure 11:	Navy Yard Circulation Alternative A	37
Figure 12:	Navy Yard Circulation Alternative B	38
Figure 13:	Medford Street Bypass Road Alignment and Access	40
Figure 14:	New England Aquarium Bus Access & Parking	42
Figure 15:	Charlestown Navy Yard Weekday Parking Accumulation	44
Figure 16:	Charlestown Navy Yard Water Shuttle Routes	50
Figure 17:	Year 2000 AM Peak Hour Build Volumes, Widened Gate #5	54
Figure 18:	Year 2000 PM Peak Hour Build Volumes, Widened Gate #5	55
Figure 19:	Year 2000 AM Peak Hour Build Volumes, New Gate #6	57
Figure 20:	Year 2000 PM Peak Hour Build Volumes, New Gate #6	58

I. INTRODUCTION

This report summarizes the findings of an analysis of the transportation implications of the proposed new Master Plan for the Charlestown Navy Yard. Included are descriptions of the analysis methodology, findings with regard to trip generation, potential auto volumes, traffic impacts on the surrounding roadways, parking demand, and the use of public transportation. Potential mitigating measures are identified and discussed related to traffic improvements for internal circulation within the Yard, access points to the Yard, and improvements on major approach routes. Also identified are both land based and water based public transportation improvements.

The analysis focuses on the first phase development, which includes the relocation of the New England Aquarium to Drydock #5 in the Yard's End area. The analysis year chosen is 1995, since this would be the first year in which all projects within the Master Plan Phase I are projected to be completed and fully occupied. For comparison, a transportation analysis of the daily and AM and PM peak vehicle trips generated by the May 10, 1988 Master Plan has also been included.[1]

In addition, a transportation analysis of Phase II development is contained at the end of the report. This second phase would be developed after 1995 and would add additional space in the Yard's End area along with new development in the proposed Special Study Area along Ninth Street and the rehabilitation of the Ropewalk. An analysis year of 2000 was chosen for the Master Plan Phase II analysis.

The report which follows draws on two earlier documents prepared by TAMS Consultants, Inc. for the Boston Redevelopment Authority and the New England Aquarium. The following documents analyze previously considered alternatives for Navy Yard development and contain detailed information on the transportation characteristics of the New England Aquarium:

- "Transportation Impacts of Alternative Development Scenarios for Charlestown;" Boston Redevelopment Authority; TAMS Consultants, Inc.; May 8, 1989.

- "New England Aquarium Charlestown Navy Yard Relocation Transportation Analysis;" New England Aquarium; TAMS Consultants, Inc.; February 15, 1989.

II. SUMMARY OF FINDINGS AND CONCLUSIONS

A. MASTER PLAN PHASE I

The results of the transportation analysis demonstrate that the Master Plan Phase I development program, including the relocation of the New England Aquarium to Drydock

[1] "Charlestown Navy Yard Master Plan," Boston Redevelopment Authority, May 10,1988.

#5, can function from a transportation perspective in the year 1995. This conclusion is based upon the assumed completion of the Central Artery North Area (CANA) project, presently scheduled for 1994, including the restoration of Chelsea Street as a continuous four lane facility between City Square and the eastern end of the Yard, and the implementation of a comprehensive program of transportation improvements for the Navy Yard. The proposed program of improvements includes the following:

1. Regional Traffic Access Improvements

- The approaches to the City Square intersection are expanded over the current DPW design with the addition of turn lanes recommended in the recent study completed for the Boston Transportation Department by the consulting firm of Vanasse Hangen Brustlin, Inc. Concurrent with resolution of the traffic geometries, a pedestrian improvement plan should be developed to enhance access by foot from the City Square area of Charlestown to the waterfront.

- A signage program is developed to direct traffic from the Route 1 and I-93 ramp termini in the City Square area to the appropriate Navy Yard entrance and parking facilities for the New England Aquarium.

2. Navy Yard Access and Circulation Improvements

- A signal is installed at Chelsea Street and Medford Street, and this signal is coordinated with the Gate #5/Chelsea Street signal and the Gate #6/Chelsea Street signal, if the latter is constructed.

- The approach to Gate #5 in the Navy Yard is widened to provide improved geometry for bus access and two exit lanes connecting in the Yard to either Thirteenth Street or Sixteenth Street. Alternatively, a new Gate #6 entrance and exit could be developed as a projection of Sixteenth Street to Chelsea Street. A new gate at this location will require a new signal along Chelsea Street.

3. Transit Service Improvements

- Bus shuttle service to the MBTA Rapid Transit and Commuter Rail lines is provided from the Navy Yard. Service should be provided a minimum of every 5 minutes during the AM and PM peak periods.

- Water shuttle services are expanded from the Navy Yard from both the existing Pier 4 terminal and a new docking facility in the Yard's End area. New services include a connection from the Navy Yard to North Station and the Russia Wharf area near South

Station and the financial district, as described in the "Boston Inner Harbor Water Transportation Study."[2]

- o During the peak summer months a dedicated high capacity water shuttle connects Central Wharf to the New England Aquarium at Drydock #5, with service marketed as part of the visitor attractions at the Aquarium and provided every 15 minutes by boats with 149-person capacity.

4. Parking Improvements

- o A parking area with sufficient capacity to accommodate up to 60 tour and school buses is developed on the property owned by the BRA along the Little Mystic Channel adjacent to Terminal Street. The Harborpark zoning provides for a 20 foot setback of surface parking from the edge of the Channel to provide continuous pedestrian access along the water's edge and a landscape buffer for the parking area.

- o A bus loading and turnaround area is developed adjacent to the Aquarium at Drydock #5. This loading area should be large enough to accommodate up to six buses at the same time.

- o The proposed parking supply of 4,510 on-street and off-street spaces in the Navy Yard is sufficient to meet the average weekday and peak summer weekend parking demand associated with the Phase I land use, including the New England Aquarium visitors and employees and the National Park visitors.

- o During the peak summer months of July and August it is forecast that the supply of 4,510 spaces would meet peak demand at 100 percent utilization. Since utilization rates above 95 percent are difficult to achieve, an additional supply of 200 seasonal parking spaces will be secured to meet Aquarium and National Park overflow parking. This additional seasonal supply can be gained by utilizing the excess capacity in the Little Mystic bus parking facility and the use of valet parking in selected garages in the Yard's End area.

5. Transportation Management Association

A Transportation Management Association will be formed including participation by the New England Aquarium, private developers in the Yard, major tenants in the Yard, the National Park Service, Charlestown community representatives, the Boston Redevelopment Authority, the Boston Transportation Department, and the MBTA. This organization should be responsible for the management of all transportation services in the Yard, the setting of goals for levels of transit use and ridesharing, the monitoring of goals achievement, and the development of additional incentives to meet goals.

---

[2] "Boston Inner Harbor Water Transportation Study;" Massport, EOTC, Legislative Special Committee on Marine Transit, MBTA, and MDPW; TAMS Consultants, Inc. and Charles Norris; October 1989.

B. SUPPLEMENTAL TRANSPORTATION IMPROVEMENTS

Additional actions could be taken to insure that the transportation system functions properly. While these are not critical to successful operation under the Master Plan Phase I development, they would provide a "margin of comfort" and could mitigate problems caused by other existing and future development in Charlestown:

1. Intra-Yard Shuttle

An intra-Yard shuttle service could be operated between the Yard's End area and New England Aquarium and National Park during peak summer periods. The shuttle would provide better utilization of the parking supply and reduce intra-Yard auto travel by tourists and visitors. A tram system might be best-suited for this service since use will occur in the summer months.

2. Internal Circulation Improvements

The traffic circulation pattern within the Yard could be modified to provide two loop patterns accessed from Gate #4 and Gates #5 and/or #6. This one way pattern could discourage through traffic movement along First Avenue and limit the traffic spill-over in the predominantly residential area west of Ninth Street.

3. Medford Street Bypass

A Medford Street Bypass could be developed using Terminal Street and the existing rail right-of-way between the Moran Terminal and Sullivan Square. Such a bypass could reduce traffic volumes on Medford Street, particularly if Medford Street is reconfigured as a neighborhood street, and provide an alternative route avoiding City Square for Navy Yard visitor and construction traffic.

C. MASTER PLAN PHASE II

The results of the transportation analysis demonstrate that the Master Plan Phase II development program can also function from a transportation perspective in the year 2000. This conclusion is based on the successful implementation of the transportation improvements identified as part of the Phase I Master Plan and the success of the identified programs in increasing the level of transit and water shuttle use beyond those achieved in 1995. Additional actions include the following:

1. Transit Service Improvements

- Shuttle bus services are expanded to meet projected demand.

- The water shuttle connection from North Station to Yard's End will be extended on to Logan Airport.

2. Parking Improvements

- o The proposed parking supply of 4,850 on-street and off-street spaces in the Navy Yard is sufficient to meet the average weekday and peak summer weekend parking demand associated with the Phase II land use, including the New England Aquarium and the National Park.

- o During the peak summer months of July and August it is forecast that an additional seasonal supply of up to 460 spaces will be needed to provide a reasonable cushion to meet peak parking demand generated by visitors to the Aquarium and National Park. In addition to the seasonal parking strategies identified for Phase I, the following actions should be considered:

  - The Phase I seasonal valet parking program should be expanded to planned garages in the Yard's End area.

  - Remote parking sites connected to the Aquarium by a shuttle bus using excess parking available during the summertime in locations such as the Bunker Hill Community College should be explored and active management by a skilled transportation coordinator would be provided.

III. BACKGROUND AND DEVELOPMENT ASSUMPTIONS

Charlestown, although a residential neighborhood for over 300 years, has long served as a funnel for traffic travelling to and from downtown Boston. The past fifteen years, however, have brought major changes to the transportation facilities which impact Charlestown. In the mid-1970's the relocation of the Orange Line to the west and the subsequent removal of the elevated tracks eliminated a blighting influence and served as an important catalyst for neighborhood redevelopment. However, this improvement also made rail transit service less accessible for many Charlestown residents, forcing greater reliance on bus service which is subject to variations in traffic.

The closing of the Navy Yard in the early 1970's and the transfer of most of the property to the City opened up a new and desirable waterfront area for commercial and residential redevelopment. Now the highway ramps connecting the Tobin Bridge (Route I) with I-93 and downtown Boston, which have long been a blighting influence on the City Square area, are being removed. The Central Artery North Area (CANA) Project, which will take five years and cost over $400 million, will not only remove a blighting physical influence but will create new parcels of land.

A. PREVIOUS STUDIES

The redevelopment of the Charlestown Navy Yard has been accompanied by a continuing planning process, which has examined a series of mixed-use development scenarios for the area. Transportation studies have been conducted for many of these scenarios as well as

proposed individual development projects. Changes in the proposed development plan have occurred as a result of changes in the Boston real estate economy, concerns raised by local residents and the opportunity presented by the relocation of the New England Aquarium to the Navy Yard. In general, all of the earlier transportation studies have come to the following general conclusions:

- From a traffic access and circulation standpoint three areas are important to the satisfactory performance of the network serving the Yard. These are illustrated in Figure 1 and include the following:

  - The majority of all Navy Yard traffic must pass through a major confluence in City Square where Chelsea Street, Rutherford Avenue, the North Washington Street Bridge and the ramps to and from I-93 and Route 1 come together. When the CANA project is completed this intersection will form the primary point of regional access to both Charlestown and the Navy Yard.

  - Traffic entering and exiting the Yard is limited to two points at present, Gates #4 and #5. The intersections along Chelsea Street at these two access points have inadequate geometry to accommodate turns by large trucks and buses. In addition, Fifth Street which leads to Gate #4 and Thirteenth Street which leads to Gate #5 have insufficient lane capacity to handle exiting traffic during evening peak commute periods. As a result, either Gate #5 must be widened or a new point of access between Chelsea Street and the Yard must be developed.

  - Internal circulation in the Yard is limited to one continuous street (First Avenue), and most streets are narrow. Thus, parking locations and access points to Chelsea Street must be carefully handled in order to avoid the creation of circulation problems within the Yard itself.

- The Navy Yard's location presents a number of transportation constraints as a result of the limited street access and lack of a direct connection to the MBTA rail system. These constraints relate primarily to conditions which occur during peak commute hours. As a result, land uses which tend to generate large volumes of peak hour auto trips, such as commercial office, create more problems than uses such as housing, research and development, and recreation facilities like the New England Aquarium.

- Significant opportunities exist to improve transit access to the Navy Yard through a combination of: (a) shuttle bus connections to the MBTA rapid transit and commuter rail system; and (b) water shuttle connections to a number of points in downtown, the South Boston Piers area and Logan Airport.

- The most effective use of the area's limited transportation capacity can be gained from a development pattern that includes a mix of uses which have travel characteristics that are spread more evenly throughout the day and are not concentrated in a single direction.

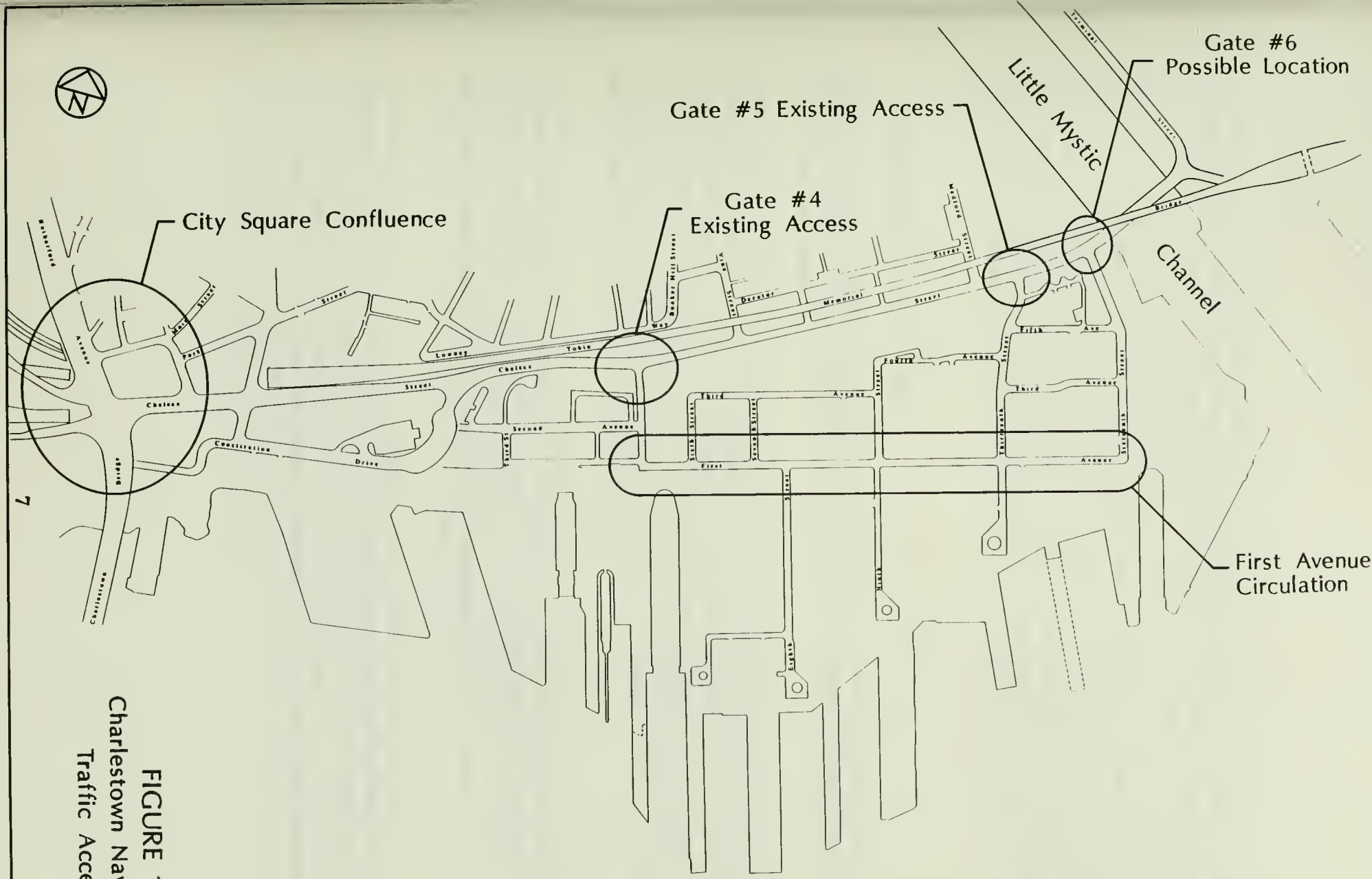


FIGURE 1
Charlestown Navy Yard
Traffic Access

B. STUDY AREA

Previous studies of the area indicate that traffic impacts of the proposed development will be concentrated along Chelsea Street between the Little Mystic Bridge and City Square. When the CANA Project is completed Chelsea Street will be restored to a continuous four lane cross section with turn lanes at key intersections between City Square and Gate #5. East of Gate #5 Chelsea Street transitions from a four lane to two lane street at the Little Mystic Channel Bridge. In City Square the CANA project design for the Chelsea Street approach consists of five lanes with a dedicated left turn lane to the Washington Street Bridge. In addition, to City Square, key intersections along Chelsea include access points to the Yard at Gates #4 and #5 and a new Gate #6, if built, and Medford Street. Medford Street will also be impacted by a limited volume of Navy Yard traffic. Beyond City Square, Navy Yard traffic will be dispersed on the arterial and expressway network and have only minimal impact on the regional network.

C. DEVELOPMENT ASSUMPTIONS

The Master Plan development consists of a mix of uses, as summarized in Table 1, and includes new office, research and development, retail, hotel and residential space along with the New England Aquarium.

Table 1 compares existing occupied space in the Yard in the spring of 1989 to space proposed in the previous plan (May 10, 1988), the Master Plan Phase I in 1995 and the Master Plan Phase II in the year 2000. Total development at the completion of Phase I would consist of 3,656,400 square feet of occupied space by the year 1995, compared to 1,559,400 square feet of occupied space existing in 1989. By the completion of Phase II in the year 2000 total development would consist of 4,973,000 square feet of space. In comparison the May 1988 Plan proposed a total build-out of 4,611,600 square feet.

The pattern of development within the Yard concentrates most new uses, including the New England Aquarium in the Yard's End area. Generally, the area west of Ninth Street will be predominantly residential with some lower density office and retail uses. The area east of Ninth Street will contain higher densities of activity in primarily office and research and development space, a new 390 room hotel and the Aquarium facility at Drydock #5. Figure 2 provides the general location of the Yard development pattern.

In addition to the Navy Yard, other development in the Charlestown area will have transportation implications for the general City Square/Chelsea Street area between now and 1995. The most significant project is the proposed redevelopment of Tudor Wharf, which is located on the waterfront between the Navy Yard and the City Square area. Current plans for Tudor Wharf call for a mixed use development consisting of approximately 250,000 square feet of office space and 30,000 square feet of retail space. This project has been included in the base background growth development assumptions.

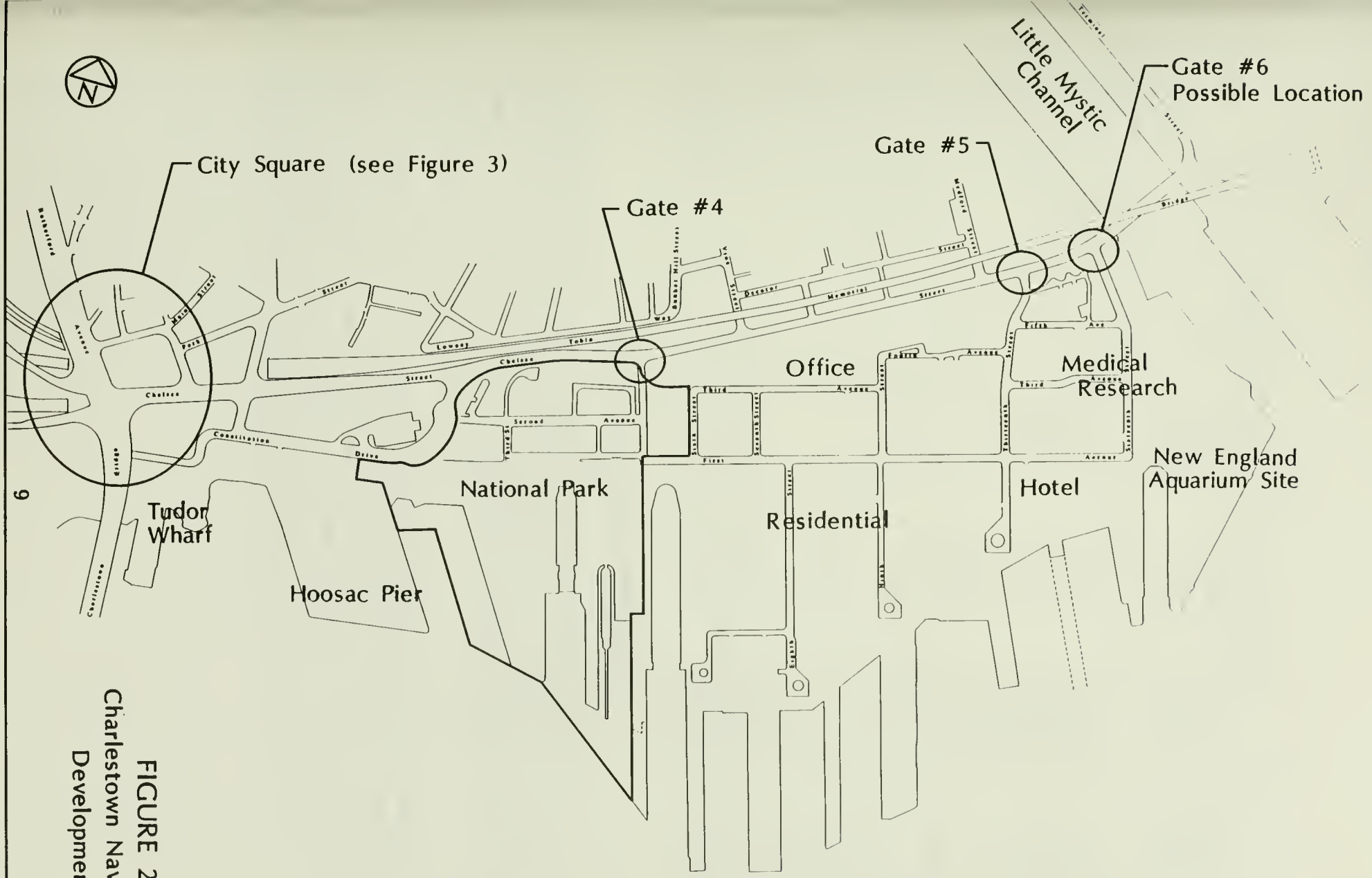


FIGURE 2
Charlestown Navy Yard
Development

TABLE 1
Charlestown Navy Yard Total Development

Land Use	Occupied April, 1989	May 1988 Master Plan	Phase I Master Plan 1995	Phase II Master Plan 2000
New Office (sq. ft.)	0	321,000	0	0
Rehab Office (sq. ft.)	246,000	473,000	403,000	403,000
Research (sq. ft.)	450,000	835,000	1,180,000	1,730,000
Retail (sq. ft.)	58,000	200,000	147,000	171,000
Hotel (sq. ft.)	0	250,000	350,000	350,000
Residential (sq. ft.)	805,400	2,318,600	1,301,400	1,699,400
Marina (boat slips)	350	525	525	525
Nursing Home (sq. ft.)	0	0	0	150,000
Cultural (sq. ft.)	0	214,000	0	195,000
Aquarium (sq. ft.)	0	0	275,000	275,000
National Park	(Included)	(Included)	(Included)	(Included)
TOTAL (sq. ft.)	1,559,400	4,611,600	3,656,400	4,973,400

IV. IMPACT ANALYSIS METHODOLOGY

The transportation impact analysis methodology employs a standard series of steps in which existing background conditions are analyzed and forecast to the design year, new travel associated with the proposed development is estimated, traffic volumes are forecast based on estimated travel by foot and transit and average vehicle occupancies, traffic is assigned to the street network, the performance of the street network is evaluated, and mitigating measures are identified to solve any identified problems.

In the case of the Navy Yard this process was altered slightly since the CANA Project will change circulation patterns in the area by the 1995 design year and previous transportation analyses had identified a number of necessary traffic and transit improvements. As a result a number of transportation improvements were assumed as an integral and necessary component of the Master Plan. The following sections describe how each of these steps was performed in the analysis. Assumed traffic improvements are described in Section V. Assumed transit improvements are detailed in Section VIII.

A. BACKGROUND TRAFFIC CONDITIONS

Background traffic volumes for the City Square and Chelsea Street areas were forecast for the 1995 design year based on traffic volumes developed for the State's design and analysis of the CANA Project. These volumes are a year 1991 forecast and have built in assumptions about future Navy Yard growth and other development which would add traffic to the area. To obtain background traffic for the Phase 1 Master Plan analysis, estimated Navy Yard traffic was subtracted from the State's CANA forecast. The resulting numbers were then inflated to 1995, assuming that other general regional development would cause background traffic to grow at one per cent per year between 1991 and 1995 and the year 2000[3]. On top of this growth the estimated traffic of the proposed Tudor Wharf project was added as documented in the Draft EIR for that project.[4]

B. NAVY YARD TRIP GENERATION METHODOLOGY

The majority of the trip generation rates for the existing and proposed uses in the Navy Yard were derived based on trip generation rates obtained from the Central Artery/Third Harbor Tunnel Project (CA/T), calibrated against actual traffic counts taken at the Navy Yard gates in April of 1989.[5] The steps in the process of calibrating the CA/T rates for the Navy Yard included the following:

- Trip generation rates, walk percentages, auto mode split percentages and average vehicle occupancy rates were extracted directly from the CA/T TRANPLAN computer model files for the analysis years 1987 and 2010 for the zones containing the Charlestown Navy Yard.

- Trip generation rates for rehabilitated office space were developed by modifying the basic office rate. This adjustment was based on surveys indicating that the rehabilitated office space in the Navy Yard contains about 4.0 employees per 1000 square feet compared to 5.0 employees per 1000 square feet in typical new office space.[6]

---

[3] The one percent per year factor was applied to all background traffic except that forecast for the Charlestown Bridge connection to downtown. Based on information supplied by the State's Central Transportation Planning Staff (CTPS), the Charlestown Bridge background volumes were held constant for future years beyond those forecast for 1991.

[4] "Tudor Wharf Draft Environmental Impact Report," EOEA #6744, September 1988, Fort Point Associates.

[5] Trip generation rates were obtained from undocumented computer files obtained from the Central Artery/Third Harbor Tunnel Project dated September 1989.

[6] Source: Boston Redevelopment Authority surveys of Navy Yard Buildings #33, #34, #36 and #39, January 29, 1990.

- Trip generation rates for research and development space were developed using the CA/T office rate and assuming that research and development uses have only 2.2 employees per 1000 square feet as compared to 5.0 employees per 1000 square feet in typical new office space.[7]

- Trip generation rates and average vehicle occupancies for residential space in the Navy Yard were also adjusted based on survey information indicating that the current average household size is 1.30, and that it will increase to 1.65 by the year 2000 compared to over 2.0 elsewhere in the Charlestown area.[8]

- Trip generation rates for the exhibit space were modified from the CA/T rate based on information obtained by the BRA from the Society for the Preservation of New England Antiquities (SPNEA) estimate that the facility in the new Ropewalk would employ approximately 40 people.

- Since no CA/T rate was available for the marina and the nursing home ITE rates were used.[9]

- Estimates of traffic generated by the National Park were developed directly from visitor data compiled in 1987.

- Estimates of construction worker and construction vehicle activity during April of 1989 were made based on an estimate by the BRA that 630 construction workers were employed in the Yard at the time that traffic counts were taken.

- These rates were then applied to the occupied uses in the Navy Yard as supplied by the BRA for April of 1989.

- The resulting vehicle trips were then compared to actual daily and peak hour counts taken on April 12 through April 15, 1989.

- To replicate the daily and AM and PM peak hour counts, the auto mode splits, walk percentages and peak hour percentages were then adjusted based on limited available data regarding existing transit use and best judgments.

- The process produced "calibrated rates" capable of reproducing what is actually observed in the field both on a daily basis and for the morning and evening peak hours.

---

[7] "Biotechnology and other Emerging Industries," Avault, John and Johnson, Mark R. Boston Redevelopment Authority, 1987.

[8] Source: Boston Redevelopment Authority surveys of rosters for existing residential buildings in the Navy Yard, January 1990.

[9] Trip Generation, 4th Edition, Institute of Transportation Engineers, Washington, D.C., 1987.

The 1989 calibrated trip generation rates, non-auto (walk, transit and water shuttle) mode share estimates and average vehicle occupancies are summarized in Table 2. Table 3 summarizes the estimated trip generation associated with uses in the Navy Yard in April of 1989 compared to the traffic counts taken at the Yard entrances. From this table it can be seen that the calibrated rates give a relatively close fit to the actual observed traffic volumes. While this process is subject to some uncertainty, it does produce a better model of actual Navy Yard traffic generation than can be obtained by using standard trip generation rates.

To obtain year 1995 and year 2000 trip rates the 1989 calibrated rates were compared to the CA/T forecast year 2010 rates. Adjustments were made to reflect increases in linked trips and an increase in walking trips among uses in the Navy Yard as a result of the development of the area as a mixed use community. Transit percentages were also increased in response to the planned improvements in bus service and the proposed water shuttle connections.

Finally, a series of sensitivity tests were conducted using different approaches to the 1989 rate calibrations. The procedure was to hold some rates constant and vary others to produce a calibration. These alternative calibrated rates were then applied to the 1995 land use to see how much variation might occur. The results of these tests indicate that the variation in the resulting total trips, that might be predicted in a future year, fall within an acceptable range.

TABLE 2
1989 Calibrated Daily Trip Generation Rates

Land Use	Units	Initial Person Trip Rate	Adjusted Person Trip Rate	Percent Non-Auto	Average Vehicle Occupancy	Vehicle Trip Generation Rate
Rehab Office	1000 Sq. Ft.	13.4	10.6	34%	1.2	5.8
Research	1000 Sq. Ft.	13.4	5.9	48%	1.2	2.5
Marina	Boat Slips	3.0	3.0	34%	2.0	1.0
Residential	1000 Sq. Ft.	14.0	11.5	37%	1.3	5.6
Retail	1000 Sq. Ft.	60.4	60.4	56%	1.3	19.3
National Park	N/A	(Estimated directly based on visitor survey data, 1987)				

TABLE 3
April 1989 Total Vehicle Trips
Existing Conditions

Land Use	Square Footage	Daily Rate	Total Daily Trips	AM Peak Trips	PM Peak Trips
Rehab Office	246,000	5.8	1,417	193	149
Research	450,000	2.5	1,106	150	117
Retail	58,000	19.3	1,119	16	68
Marina (slips)	350	0.7	251	4	8
Residential	805,400	5.6	4,519	235	297
National Park	N/A	N/A	489	24	42
Construction (workers)	630	1.9	1,208	169	121
TOTALS	1,559,400		10,109	792	802
COUNTS (4/89)			10,122	770	807

The resulting 1995 and 2000 daily trip generation rates, mode share estimates and average vehicle occupancies are summarized in Table 4. This Table is organized by primary land use category and compares the daily statistics for 6 forecasts, as follows:

- 1987 Central Artery calibrated rates (CA/T 1987),
- 1989 Charlestown Navy Yard calibrated rates (CNY 1989),
- 1995 Charlestown Navy Yard forecast rates (CNY 1995),
- 1995 Charlestown Navy Yard forecast rates for May 1988 Master Plan (5/88 Master Plan),
- 2000 Charlestown Navy Yard forecast rates (CNY 2000), and
- 2010 Central Artery forecast rates (CA/T).

The table shows the following by column:

- The estimated person trip end rate by land use category;
- The estimated percentage of all daily trips that will be made by walking, transit and auto;
- The estimated number of people in each auto; and

- The resulting vehicle trip rate, which is calculated as the product of the person trip rate and the auto percentage divided by the average vehicle occupancy.

All figures shown in the tables are daily averages, the actual trip computations subdivided travel by work and non-work purposes and applied differing factors for each. As an example, the transit percentage for research space work trips was calibrated at 45 percent of vehicular trips (43 percent of person trips) in 1989, and was forecast to increase to 55 percent of vehicular trips (50 percent of person trips) in 1995.

Estimates of the traffic generated by the New England Aquarium and the National Park were developed directly based on forecasts of visitor volumes, time of day of arrivals, length of stay, party size and auto use by visitors. Both of these uses have patterns of visitation that are highly peaked in the summer. Therefore, two estimates were performed for each, one for the average year round condition and one for the peak condition in August. Key assumptions underlying the Aquarium forecasts include:[10]

- The Aquarium will have 2.1 million visitors and a workforce of 300 in the year 1995.
- Visitation to the Aquarium will peak in the early years and drop off to an average of 1.8 million by the year 2000.
- Monthly, daily and hourly distributions of visitors will be the same as those now experienced at Central Wharf.
- 27 percent of visitors to the Aquarium will arrive by means other than auto (walking, the water shuttle from downtown, school and tour buses, and public transit).
- Of those who drive, the average party size will be 2.5 people.
- Of the current visitors to the National Park, 250,000 will also go to the Aquarium on the same trip.

---

[10] "New England Aquarium Charlestown Navy Yard Relocation Transportation Analysis," New England Aquarium, TAMS Consultants, Inc., February 15, 1989.

TABLE 4
Comparison of Daily Trip Generation Rates, Charlestown Navy Yard

Land Use: New Office (per 1,000 sq. ft.)

Source	Design Year	Person Trip End Rate	% Walk	% Transit	% Auto	Average Vehicle Occupancy	Vehicle Trip End Rate
CA/T	1987	13.4	18%	16%	66%	1.2	7.4
CNY Calibration	1989	(No new office space in Navy Yard in 1989.)					
CNY Phase I	1995	(No new office space in Navy Yard in Phase I.)					
5/88 Master Plan	1995	13.4	22%	18%	60%	1.2	6.6
CNY Phase II	2000	(No new office space in Navy Yard in Phase II.)					
CA/T	2010	13.4	18%	17%	65%	1.2	7.2

Land Use: Rehabilitated Office (per 1,000 sq. ft.)

Source	Design Year	Person Trip End Rate	% Walk	% Transit	% Auto	Average Vehicle Occupancy	Vehicle Trip End Rate
CA/T	1987	(No rate available.)					
CNY Calibration(1)	1989	10.6	18%	15%	67%	1.2	5.8
CNY Phase I	1995	10.6	22%	17%	61%	1.2	5.3
5/88 Master Plan	1995	10.6	22%	17%	61%	1.2	5.3
CNY Phase II	2000	10.6	22%	22%	56%	1.2	4.9
CA/T	2010	(No rate available.)					

Notes: (1) Person trip rate derived by taking the CA/T office rate and adjusting density from 5 to 4 employees/1000 sq. ft.

TABLE 4
Comparison of Daily Trip Generation Rates, Charlestown Navy Yard
(continued)

Land Use: Research (per 1,000 sq. ft.)

Source	Design Year	Person Trip End Rate	% Walk	% Transit	% Auto	Average Vehicle Occupancy	Vehicle Trip End Rate
CA/T	1987			(No rate available.)			
CNY Calibration(1)	1989	5.9	18%	30%	52%	1.2	2.5
CNY Phase I	1995	5.9	23%	35%	42%	1.2	2.0
5/88 Master Plan	1995	5.9	23%	35%	42%	1.2	2.0
CNY Phase II	2000	5.9	23%	38%	39%	1.2	1.9
CA/T	2010			(No rate available.)			

Notes: (1) Person trip rate derived by taking the CA/T office rate and adjusting density from 5 to 2.2 employees/1000 sq. ft.

Land Use: Retail (per 1,000 sq. ft.)

Source	Design Year	Person Trip End Rate	% Walk	% Transit	% Auto	Average Vehicle Occupancy	Vehicle Trip End Rate
CA/T	1987	60.4	43%	10%	47%	1.3	22.0
CNY Calibration	1989	60.4	46%	10%	44%	1.3	19.3
CNY Phase I	1995	60.4	60%	15%	25%	1.3	11.9
5/88 Master Plan	1995	60.4	60%	15%	25%	1.3	11.9
CNY Phase II	2000	60.4	60%	17%	23%	1.3	11.1
CA/T	2010	60.4	43%	17%	40%	1.3	18.6

TABLE 4
Comparison of Daily Trip Generation Rates, Charlestown Navy Yard
(continued)

Land Use: Residential (per 1,000 sq. ft.)

Source	Design Year	Person Trip End Rate	% Walk	% Transit	% Auto	Average Vehicle Occupancy	Vehicle Trip End Rate
CA/T	1987	14.0	32%	23%	45%	1.5	4.2
CNY Calibration(1)	1989	11.5	25%	12%	63%	1.3	5.6
CNY Phase I	1995	11.5	32%	20%	48%	1.3	4.2
5/88 Master Plan	1995	11.5	32%	20%	48%	1.3	4.2
CNY Phase II	2000	11.5	32%	29%	39%	1.3	3.4
CA/T	2010	14.0	32%	29%	39%	1.5	3.6

Notes: (1) Person trip rate derived by taking the CA/T residential rate and adjusting for density change from 2.0 to 1.65 persons/dwelling unit

Land Use: Hotel (per 1,000 sq. ft.)

Source	Design Year	Person Trip End Rate	% Walk	% Transit	% Auto	Average Vehicle Occupancy	Vehicle Trip End Rate
CA/T	1987	17.6	39%	13%	48%	1.3	6.5
CNY Calibration	1989			(No hotel in the Navy Yard in 1989.)			
CNY Phase I	1995	17.6	39%	15%	46%	1.3	6.3
5/88 Master Plan	1995	17.6	39%	15%	46%	1.3	6.3
CNY Phase II	2000	17.6	39%	18%	43%	1.3	5.9
CA/T	2010	17.6	39%	15%	46%	1.3	6.2

Key assumptions for the National Park include:[11]

- o Annual visitation will be 1.1 million in 1995, and grow at an annual rate of 3 percent a year to the year 2000.

- o Monthly, daily and hourly distributions of visitors will be the same as those now experienced.

- o The current pattern of auto use by 38 percent of all visitors will continue with an average party size of 2.5 people.

- o Employment by the National Park will not increase over current levels.

The results of the traffic forecasts for April and August of 1995 are summarized in the accompanying Tables 5 and 7, respectively. Tables 6 and 8 illustrate the estimated vehicle traffic generation of the May 1988 Master Plan for the Yard, using the same trip generation assumptions. By comparing Tables 5 and 6 it can be seen that the new Master Plan Phase I will generate approximately 3,900 fewer daily trips and nearly 300 fewer PM peak hour trips compared to the May 1988 Master Plan during the majority of the year, as represented by the April condition. During the peak summer tourist season of July and August the new Phase I Master Plan will generate approximately 1,900 fewer daily trips and roughly the same number of PM peak hour trips compared to the May 1988 Master Plan, as represented by the August condition.

[11] "Visitor Statistics and Information Boston National Historical Park," U.S. Dept. of the Interior, National Park Service, March 4, 1987.

TABLE 5
April 1995 Total Vehicle Trips,
Phase I Master Plan

Land Use	Square Footage	Daily Rate	Total Daily Trips	AM Peak Trips	PM Peak Trips
Rehab Office	403,000	5.3	2,121	288	224
Research	1,180,000	2.0	2,349	319	248
Retail	147,000	11.9	1,754	25	107
Hotel	350,000	6.3	2,207	132	132
Marina (slips)	525	0.7	377	6	11
Residential	1,301,400	4.2	5,476	285	360
National Park	N/A	N/A	621	24	53
Aquarium	275,000	N/A	2,367	46	267
TOTALS	3,656,400		17,271	1,127	1,403

TABLE 6
April 1995 Total Vehicle Trips,
May 1988 Master Plan

Land Use	Square Footage	Daily Rate	Total Daily Trips	AM Peak Trips	PM Peak Trips
Rehab Office	473,000	5.3	2,489	338	262
New Office	321,000	6.6	2,133	290	225
Research	835,000	2.0	1,662	226	175
Retail	200,000	11.9	2,386	34	146
Hotel	250,000	6.3	1,576	95	95
Marina (slips)	525	0.7	377	6	11
Residential	2,318,600	4.2	9,757	507	642
National Park	N/A	N/A	621	24	53
Cultural	214,000	0.9	202	13	85
TOTALS	4,611,600		21,203	1,535	1,694

TABLE 7
August 1995 Total Vehicle Trips
Phase I Master Plan

Land Use	Square Footage	Daily Rate	Total Daily Trips	AM Peak Trips	PM Peak Trips
Rehab Office	403,000	5.3	2,121	288	224
Research	1,180,000	2.0	2,349	319	248
Retail	147,000	11.9	1,754	25	107
Hotel	350,000	6.3	2,207	132	132
Marina (slips)	525	1.2	629	11	19
Residential	1,301,400	4.2	5,476	285	360
National Park	N/A	N/A	1,838	24	156
Aquarium	275,000	N/A	4,471	46	481
TOTALS	3,656,400		20,844	1,130	1,727

TABLE 8
August 1995 Total Vehicle Trips
May 1988 Master Plan

Land Use	Square Footage	Daily Rate	Total Daily Trips	AM Peak Trips	PM Peak Trips
Rehab Office	473,000	5.3	2,489	338	262
New Office	321,000	6.6	2,133	290	225
Research	835,000	2.0	1,662	226	175
Retail	200,000	11.9	2,386	34	146
Hotel	250,000	6.3	1,576	95	95
Marina (slips)	525	1.2	629	11	19
Residential	2,318,600	4.2	9,757	507	642
National Park	N/A	N/A	1,838	24	156
Cultural	214,000	1.3	269	13	88
TOTALS	4,611,600		22,739	1,539	1,808

C. NAVY YARD TRAFFIC DISTRIBUTION AND ASSIGNMENT

Traffic was distributed in and out of the Yard based on the proposed parking locations to either Gate #4 or Gates #5 and/or #6 and then to the balance of the street network based on the forecasts developed by the Central Transportation Planning Staff (CTPS).[12] All traffic generated by uses in the Navy Yard was assumed to be accommodated in parking facilities built within the Yard. The regional distribution of travel to and from the Yard is summarized in Table 9. The resulting distribution and assignment results in 100 percent of the traffic being assigned to Chelsea Street. Of the total amount approximately 70 percent proceeds on Chelsea to the City Square intersection. The balance of 30 percent of the traffic is assigned from Chelsea Street to Medford Street (18 percent) and Warren Street (12 percent).

TABLE 9

Distribution of Navy Yard Auto Trips

Corridor	Street Assignment	Percent of All Traffic
Route 1 North (Tobin Bridge)	100% City Square	24
Routes 99 & 28	70% City Square/30% Medford	5
I-93 North	100% Medford	12
Prison Point Bridge	33% City Square/67% Warren	4
Artery Charlestown Bridge	100% City Square	40
Local	30% Medford/70% Warren	15
	TOTAL	100

D. TRAFFIC ANALYSIS

Following the assignment of traffic to the street network, intersection Level of Service (LOS) analyses were performed at the key intersections of Chelsea Street with Gate #4, Chelsea Street and Medford Street, Chelsea Street with Gates #5 and/or #6 and City Square.

No analysis of traffic conditions within the Navy Yard were undertaken, since previous studies had determined that conditions were generally acceptable under a range of development alternatives. In addition, this study identifies a number of Yard access and internal circulation alternatives that warrant further study before any new analysis is undertaken.

The traffic analyses relies on a determination of intersection level of service measures for the evaluation of impacts. Analysis of traffic capacity and operations was conducted using

[12] Memorandum to North Area Project Final Design Files from Tom Lisco, Central Transportation Planning Staff, June 20, 1986.

methodologies described in the 1985 Highway Capacity Manual, Special Report 209. Level of service for signalized intersections is defined in terms of the average stopped delay per vehicle. The criteria are summarized in Table 10.

TABLE 10
Level Of Service Criteria For Signalized Intersections

Level of Service (LOS)	Stopped Delay Per Vehicle (Seconds)
A	≤ 5.0
B	5.1 to 15.0
C	15.1 to 25.0
D*	25.1 to 40.0
E	41.0 to 60.0
F	> 60.0

* Level of Service D is generally considered acceptable in urban areas.

V. TRAFFIC ANALYSIS FINDINGS

This section describes the findings of the traffic analysis for the Master Plan Phase I development in the year 1995, under three alternative assumptions regarding access improvements in the area. The City Square intersection was analyzed both under its current design and with the design modifications proposed by the Boston Transportation Department. Access to the Yard was analyzed for two alternatives. The first option assumed the widening and realignment of Gate #5 to provide two exit lanes. The second option assumed the development of a new Gate #6 as a projection of Sixteenth Street to a new intersection with Chelsea Street. For each case it was assumed that the intersection of Chelsea and Medford Streets would be signalized. All analyses were conducted based on projected peak summer weekday volumes, representative of conditions that would occur during August of 1995 when visitation to both the New England Aquarium and the National Park would be at the highest.

A. CITY SQUARE INTERSECTION

Two options for City Square were evaluated. The first analysis assumed that the intersection would be constructed as currently planned by the Massachusetts Department of Public Works (DPW) following completion of the CANA Project. The second analysis examined the performance of the intersection with a series of improvements proposed by the Boston Transportation Department. In November 1987, Vanasse Hangen Brustlin, Inc. (VHB) undertook a study for the Boston Transportation Department of the local intersections in the vicinity of the CANA Project, including the new City Square intersection.[13] A number of

[13] "Central Artery North Area Local Intersection Analysis," City of Boston Transportation Department, Vanasse Hangen Brustlin, Inc., November, 1987.

layout modifications to the Massachusetts Department of Public Works (DPW) scheme were recommended to improve the capacity, as follows:

- Dual left turn lanes to Chelsea Street on the Rutherford Avenue approach (southbound).
- An exclusive right turn lane to Chelsea Street on the Charlestown Bridge approach (northbound).
- An exclusive left turn lane to Rutherford Avenue on the I-93 off-ramp (eastbound).
- Dual left turn lanes instead of a single left turn lane from Chelsea Street to the North Washington Street Bridge southbound.

The VHB scheme, which is now under consideration by the Massachusetts DPW, is shown in Figure 3. The Charlestown Navy Yard Master Plan includes various recommendations for enhancing pedestrian access from the surrounding community to the Navy Yard. The City Square intersection and Chelsea Street corridor from City Square to the Navy Yard will continue to be evaluated from a similar perspective to ensure that the State roadway improvements also result in enhanced pedestrian access from the surrounding community to the waterfront.

Figures 4 and 5 illustrate the projected AM and PM peak hour turn movements at City Square for a typical weekday in August of 1995. Findings of the City Square Level of Service analysis for both designs are summarized in Table 11. From the results it can be seen that the intersection will be severely congested and operate at Level F during both the AM and PM peak hours under the current DPW design. With the proposed BTD improvements these impacts are reduced and an acceptable Level of Service D results for both time periods.

TABLE 11
City Square Signalized Intersection Analysis 1995

Alternative	LOS	Delay (sec.)
DPW Design		
AM Peak	F	69
PM Peak	F	116
VHB Design		
AM Peak	D*	31
PM Peak	D*	35

* At least one move is at level of service "E".

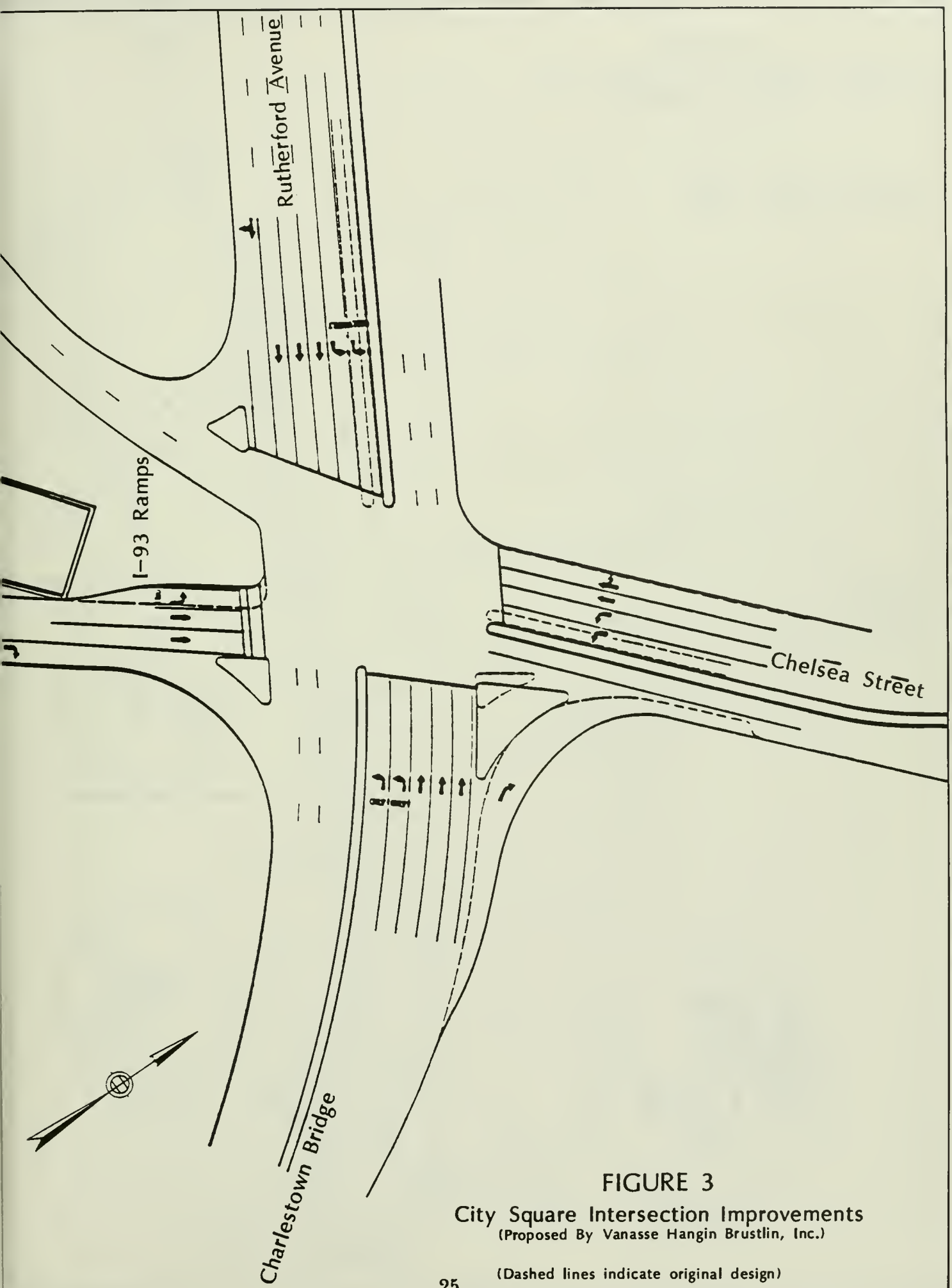


FIGURE 3

City Square Intersection Improvements

(Proposed By Vanasse Hangin Brustlin, Inc.)

(Dashed lines indicate original design)

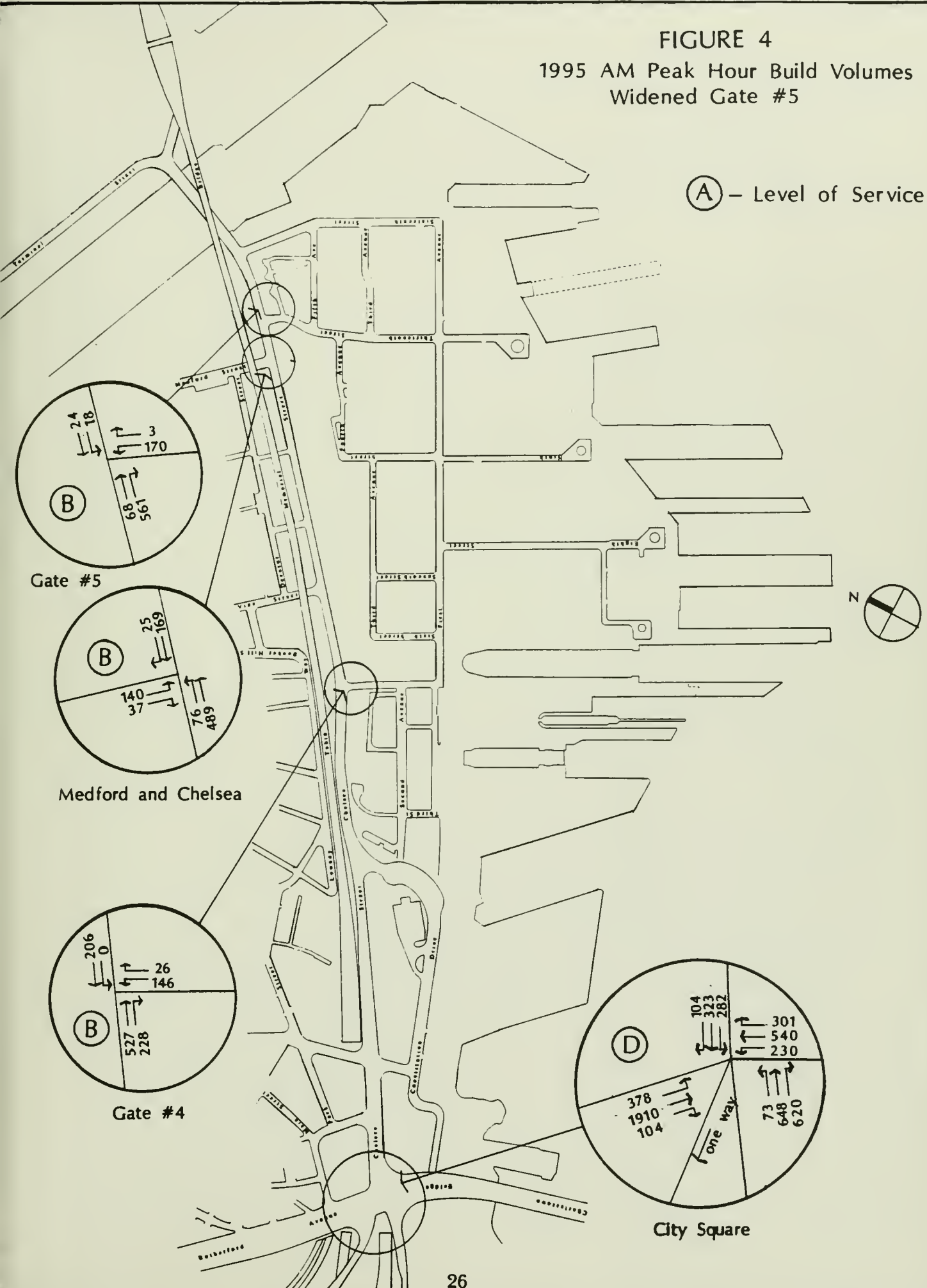
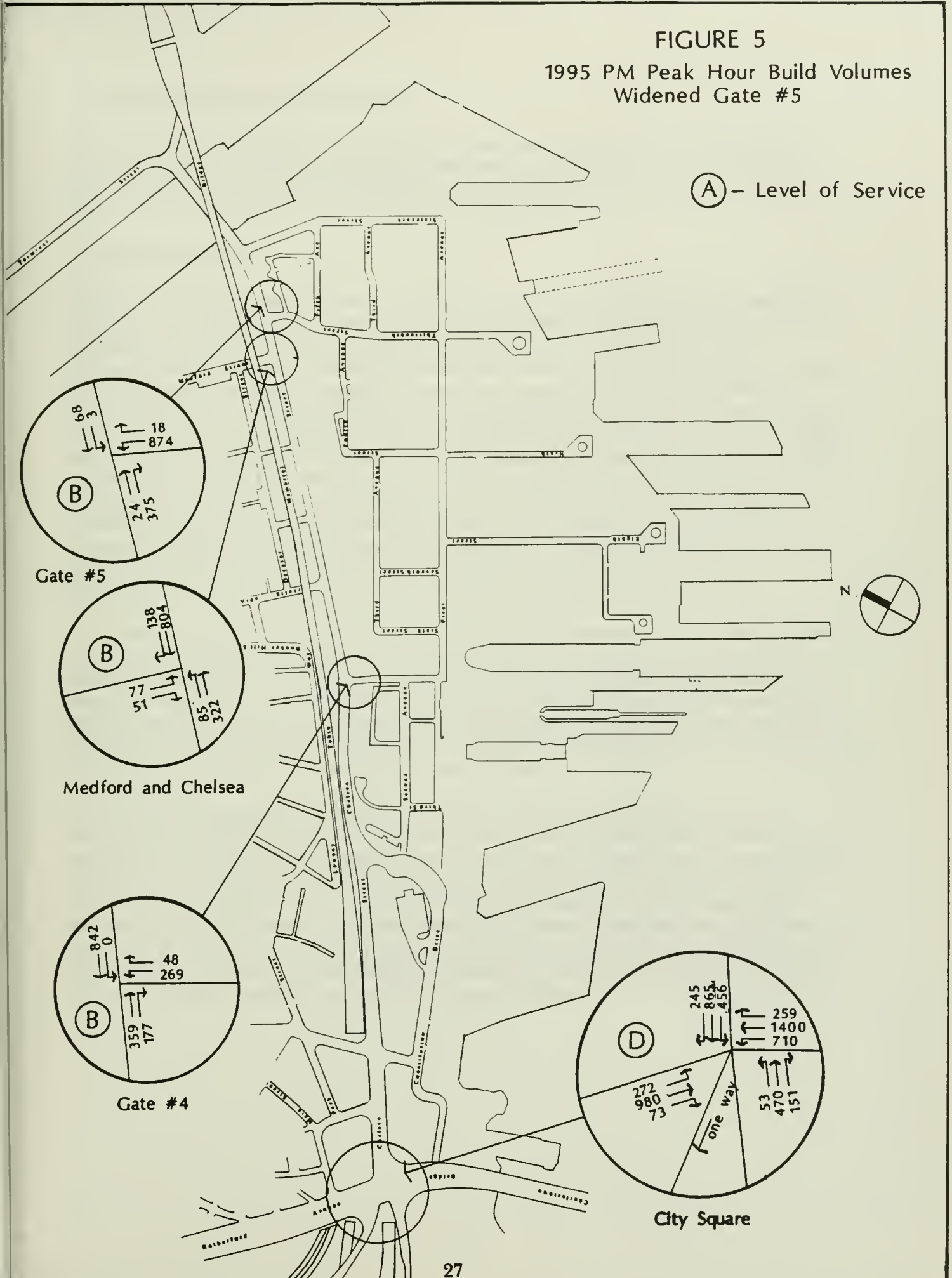


FIGURE 4
1995 AM Peak Hour Build Volumes
Widened Gate #5
(A) – Level of Service
B
24
18
3
170
68
561
Gate #5
B
25
169
140
37
76
489
Medford and Chelsea
B
206
0
26
146
527
228
Gate #4
D
104
323
282
301
540
230
378
1910
104
one way
73
648
620
City Square
N

FIGURE 5

1995 PM Peak Hour Build Volumes
Widened Gate #5

(A) – Level of Service



B. CHELSEA STREET INTERSECTIONS

The intersections of Chelsea Street with Fifth Street (Gate #4), Medford Street, Thirteenth Street (Gate #5), and Sixteenth Street (Gate #6) were analyzed under two scenarios of improved Yard access. Since earlier studies had identified the need for improved access at Yard's End two alternatives were identified and evaluated.

1. Widened Gate #5

The proposed improvement to Gate #5 is shown conceptually in Figure 6. The approach to Gate #5 would be realigned to form a 90 degree angle with Chelsea Street in order to facilitate bus and large truck movements in and out of the Yard's End area. A new intersection with Fifth Avenue would be formed that would establish Sixteenth Street (rather than Thirteenth Street) as the major north-south connector within the Yard's End area. Geometric design would accommodate bus turning movements on Sixteenth Street, but not on Thirteenth Street. Approximately 160 feet of storage for queued vehicles would be available for vehicles exiting the site. The profile of the new access road would be approximately 3-4 percent, rising toward Chelsea Street. The alignment would require that Building "P" and the existing tennis court be relocated. Preliminary costs for this conceptual improvement are estimated to be $660,000 in 1990 dollars. Included in this estimate are provisions for the relocation of Building "P" to a site immediately west of the realigned Gate #5 entrance and the removal of the oil tanks under the tennis courts. No costs for the rehabilitation of Building "P" or the construction of a new foundation have been included.

An optional configuration for improving Gate #5 was also examined, which would maintain the existing alignment but widen Thirteenth Street to provide two exit lanes. Figure 7 illustrates this alternative. This alternative also requires the relocation of Building "P", but does not necessitate the removal of the tennis courts. Preliminary costs for this conceptual improvement are estimated to be $495,000 in 1990 dollars. Included in this estimate are provisions for the relocation of Building "P". No costs for the rehabilitation of Building "P" or the construction of a new foundation have been included.

Other assumed improvements include the restoration of Chelsea Street as part of the completion of the CANA project to a full four lane cross section west of Gate #5 and the signalization of Medford and Chelsea Streets. Figures 4 and 5 illustrate the forecast AM and PM peak hour turn movements at the Chelsea Street and Gate #4, Chelsea Street and Medford Street and Chelsea Street and Gate #5 intersections, during an average August weekday in 1995. The results of the intersection level of service analysis under this alternative improvement are summarized in Table 12. Conclusions of the analysis are that all three intersections will operate at an acceptable level of service during the AM and PM peak hours of a typical August weekday when traffic volumes are highest.

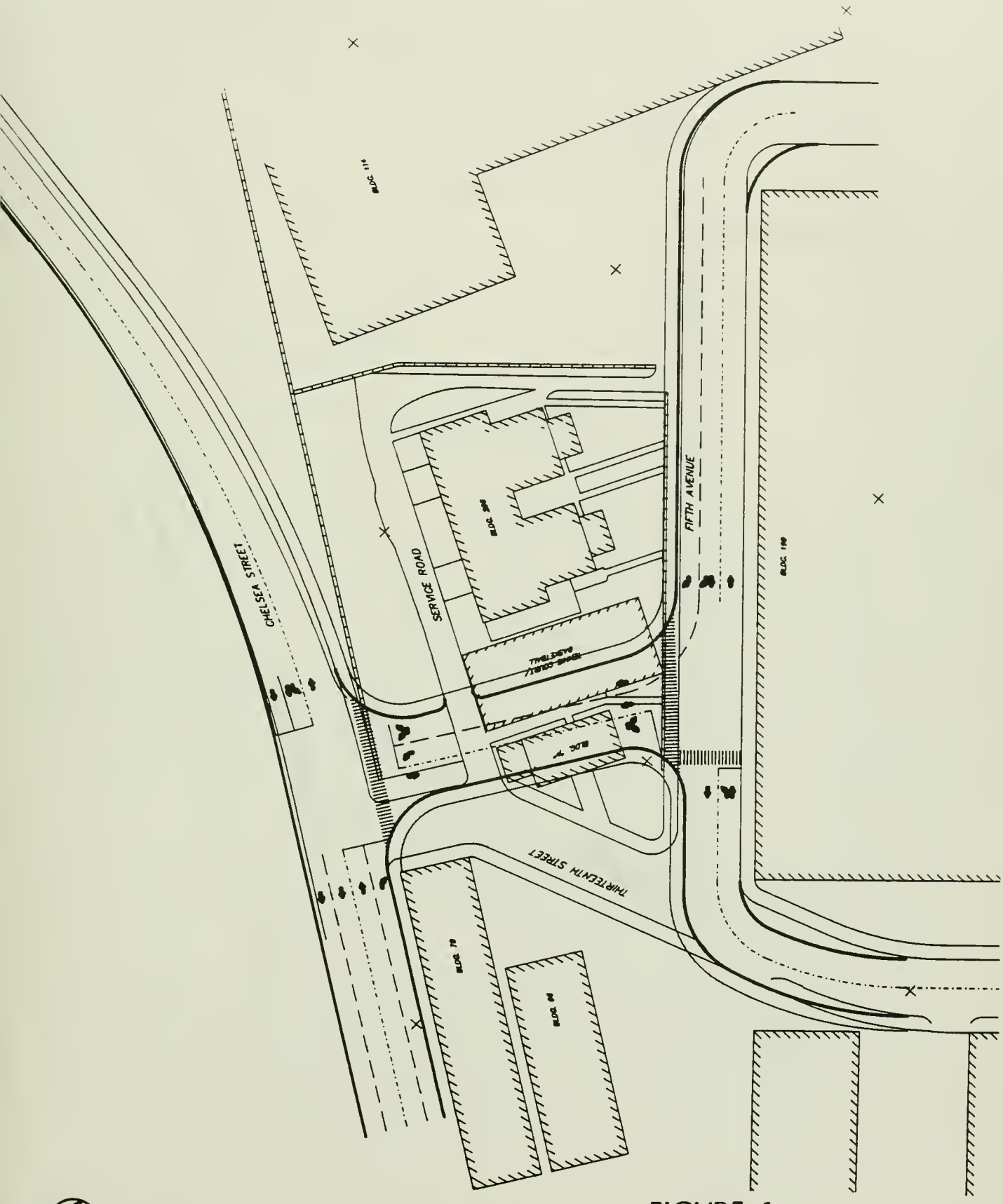


FIGURE 6

Gate #5 Widening And Realignment Conceptual Plan

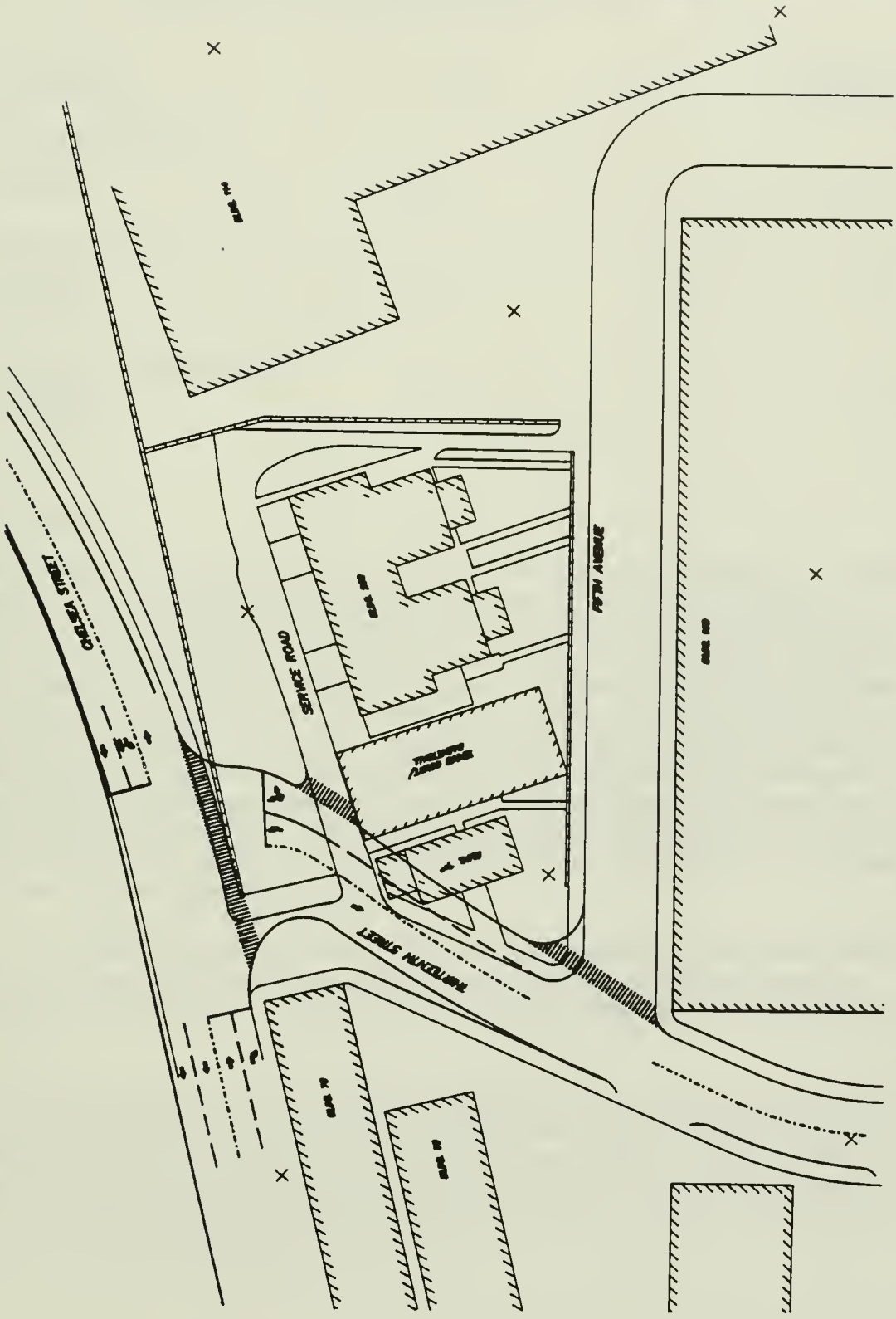


FIGURE 7
Gate #5 Option 2: Widening Only
Conceptual Plan

TABLE 12
Chelsea Street Signalized Intersection Analysis 1995
Widened Gate #5

Intersection	LOS	Delay (sec.)
Gate 4 (Fifth Street)		
AM Peak	B	6
PM Peak	B	9
Medford Street		
AM Peak	B	9
PM Peak	B	6
Gate 5 (Thirteenth Street)		
AM Peak	B	7
PM Peak	B	13

2. New Gate #6

As an alternative to widening and realigning Gate #5 the option of developing a new Gate #6 was examined. The conceptual alignment for a new Gate #6 is shown in Figure 8. The approach to Gate #6 would be formed by the extension of Sixteenth Street to a 90 degree intersection with Chelsea Street. This alignment even more clearly establishes Sixteenth Street as the major north-south Yard's End connector. The profile of the Sixteenth Street connector would be in the range of 5-6 percent. The alignment would require the removal of the west wing of Building #114. Chelsea Street would also require widening to provide two full receiving lanes for the double left turns from Gate #6 to Chelsea Street westbound. Horizontal sight distance appears adequate, and vertical sight distance (controlled by the crest of the bridge) also appears sufficient for a design speed of 30-35 miles per hour. Preliminary estimates of the cost to develop a new Gate #6 are $410,000 in 1990 dollars, not including the cost to remove the west wing of Building #114.

Because the new Gate #6 results in three closely spaced signalized intersections on Chelsea Street, coordination of the signal operations will be required. It may prove desireable, depending on actual experience, to limit access in and out of Gate #5 during the AM and PM peak periods.

Figures 9 and 10 illustrate the forecast AM and PM peak hour turn movements at the Chelsea Street and Gate #4, Chelsea Street and Medford Street, Chelsea Street and Gate #5, and Chelsea Street and Gate #6 intersections, during an average August weekday in 1995. The findings of the level of service analysis for the operation of a new Gate #6 are summarized in Table 13. The analysis assumes that Gate #5 would be limited to right turns in and right turns out only during the AM and PM peak hours.

FIGURE 8
Gate #6 Conceptual Plan

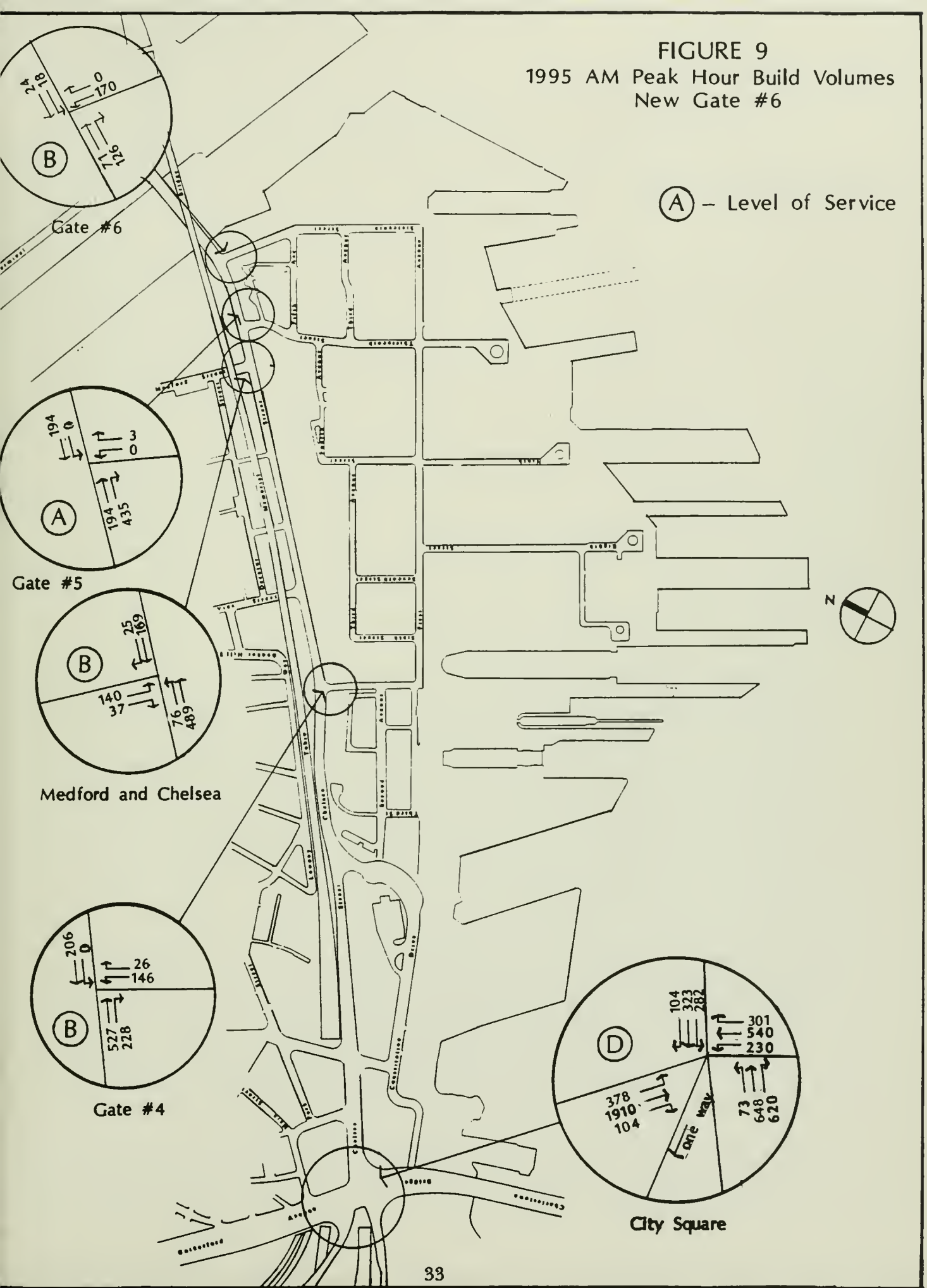


FIGURE 9
1995 AM Peak Hour Build Volumes
New Gate #6
(A) – Level of Service
Gate #6
B
24
18
0
170
71
126
Gate #5
A
194
0
3
0
194
435
Medford and Chelsea
B
25
169
140
37
76
489
Gate #4
B
206
0
26
146
527
228
City Square
D
104
323
282
301
540
230
378
1910
104
one way
73
648
620
N

FIGURE 10
1995 PM Peak Hour Build Volumes
New Gate #6

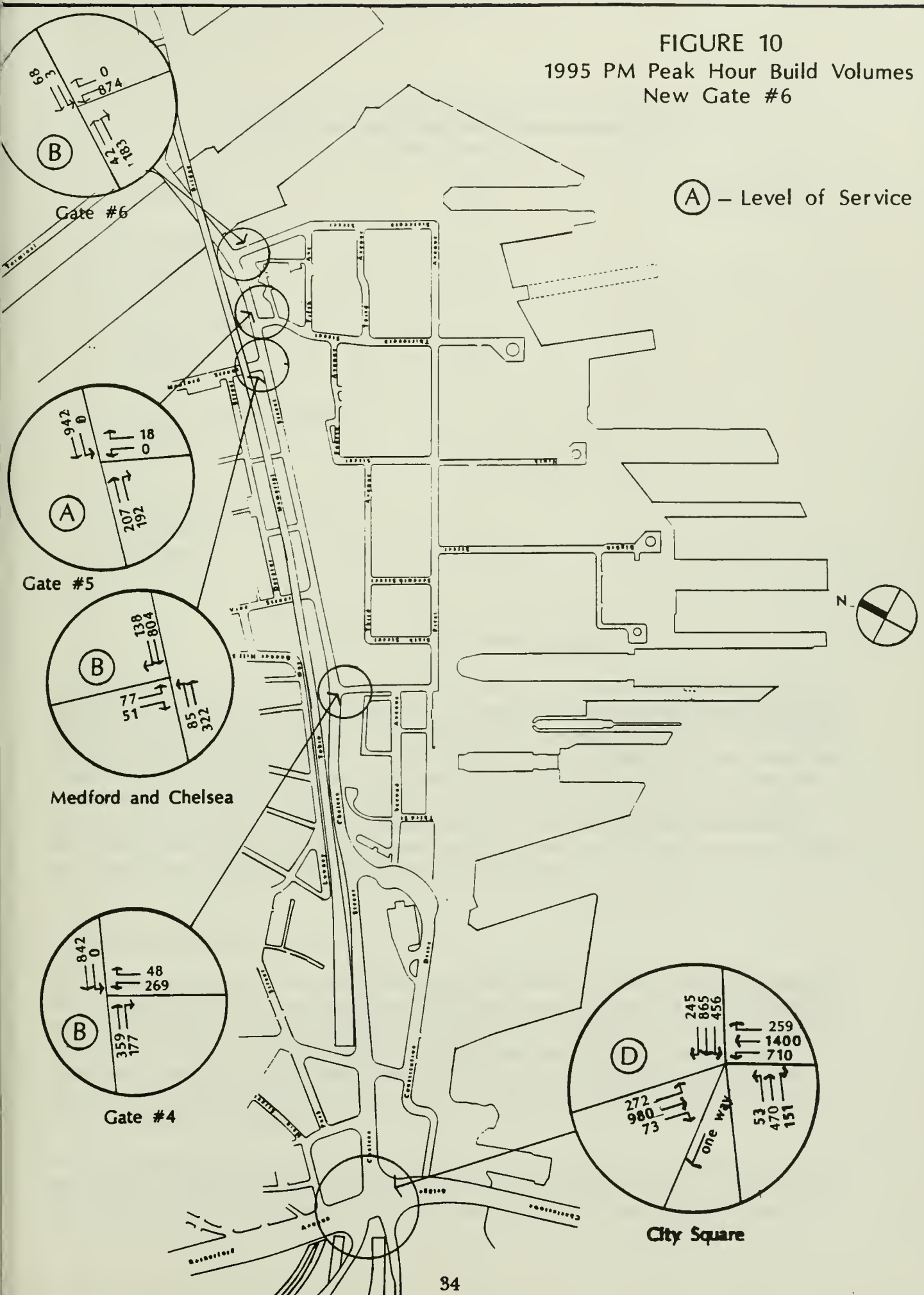


TABLE 13
Chelsea Street Signalized Intersection Analysis 1995
New Gate #6

Intersection	LOS	Delay (sec.)
Gate 4 (Fifth Street)		
AM Peak	B	6
PM Peak	B	9
Medford Street		
AM Peak	B	9
PM Peak	B	6
Gate 5 (Thirteenth Street)		
AM Peak	A	2
PM Peak	A	1
Gate 6 (Sixteenth Street)		
AM Peak	B	10
PM Peak	B	6

VI. CIRCULATION IMPROVEMENTS

Traffic circulation patterns within the Navy Yard will be a function of both parking facility location and access points from Chelsea Street. In addition, the New England Aquarium will generate a significant volume of tour and school bus traffic which will enter and exit the Yard through either Gate #5 or Gate #6. In order improve access a number of actions beyond the widening of Gate #5 or addition of a new Gate #6 were examined both in and outside the Yard. These include the development of a one way loop pattern in the Yard to discourage through traffic along First Avenue, the development of a Medford Street Bypass to divert some Navy Yard traffic from Medford Street and City Square, and the development of a plan to accommodate the Aquarium's bus access and parking needs.

A. INTERNAL CIRCULATION

With general access limited to two points along Chelsea Street and First Avenue providing the only continuous link from one end of the Yard to the other, concerns have been raised about the possible impacts of excessive volumes of through traffic along First Avenue. The primary concern is the impact of large volumes of traffic between Gate #4 and the high density development and Aquarium located in the Yard's End area. While signage along Chelsea Street can encourage this traffic to enter at Gates #5 and/or #6, positive barriers within the Yard could also be developed.

Several alternatives for internal traffic flow within the Navy Yard were considered to address this concern. All involve the changing of street directions in such a way as to set-up two one way loop patterns, one from Gate #4 and one from Gates #5/#6. Two alternatives were

selected for further review. In both cases Ninth Street was chosen as the dividing line between the two loops. The following sections discuss these schemes, which are illustrated on the accompanying Figures 11 and 12. Further analysis of these alternatives will include assessments of available street widths, property and garage access needs, parking impacts and intersection level of service impacts.

1. Internal Circulation Alternative A (Figure 11)

This option sets up two one way loops on either side of Ninth Street. The changes required to accomplish this include the development of the following one way segments:

- First Avenue one way eastbound between Eighth and Ninth Streets,
- First Avenue one way westbound between Thirteenth and Ninth Streets,
- Ninth Street one way northbound between First and Third Avenues, and
- Fourth Avenue one way eastbound between Ninth and Thirteenth Streets.

With these changes traffic entering at Gate #4 has ready access to all areas of the Yard up to Ninth Street. East of Ninth Street access would become quite circuitous, although possible by turning north on Ninth, east on Fourth and west on Thirteenth. From Gates #5 and #6 access is direct to most areas up to Ninth Street. Reaching points west of Ninth from Gates #5 and #6 would be possible but again quite circuitous.

The advantages of this scheme are that it discourages but does not totally prevent movement from one end of the Yard to the other, would maintain continuous emergency vehicle access along First Avenue and could include an exclusive bus lane if it were determined desireable to operate a shuttle or tram between the two ends of the Yard. The primary disadvantage is that it would depend on enforcement of the one way segments, especially if bus lanes are included.

2. Internal Circulation Alternative B (Figure 12)

This option would establish the same one way pattern described for Alternative A, but would add a barrier on Ninth Street between First and Third Avenues to physically prevent cross Yard trips in either direction. In order to accomplish the physical separation, Ninth Street would have to be widened by approximately twenty feet to allow proper lateral clearance. The barriers would have to be mountable for emergency vehicle access.

The advantage of this option is that it is self-enforcing. The disadvantages include the need to widen Ninth Street and the fact that all cross Yard movement is prevented.

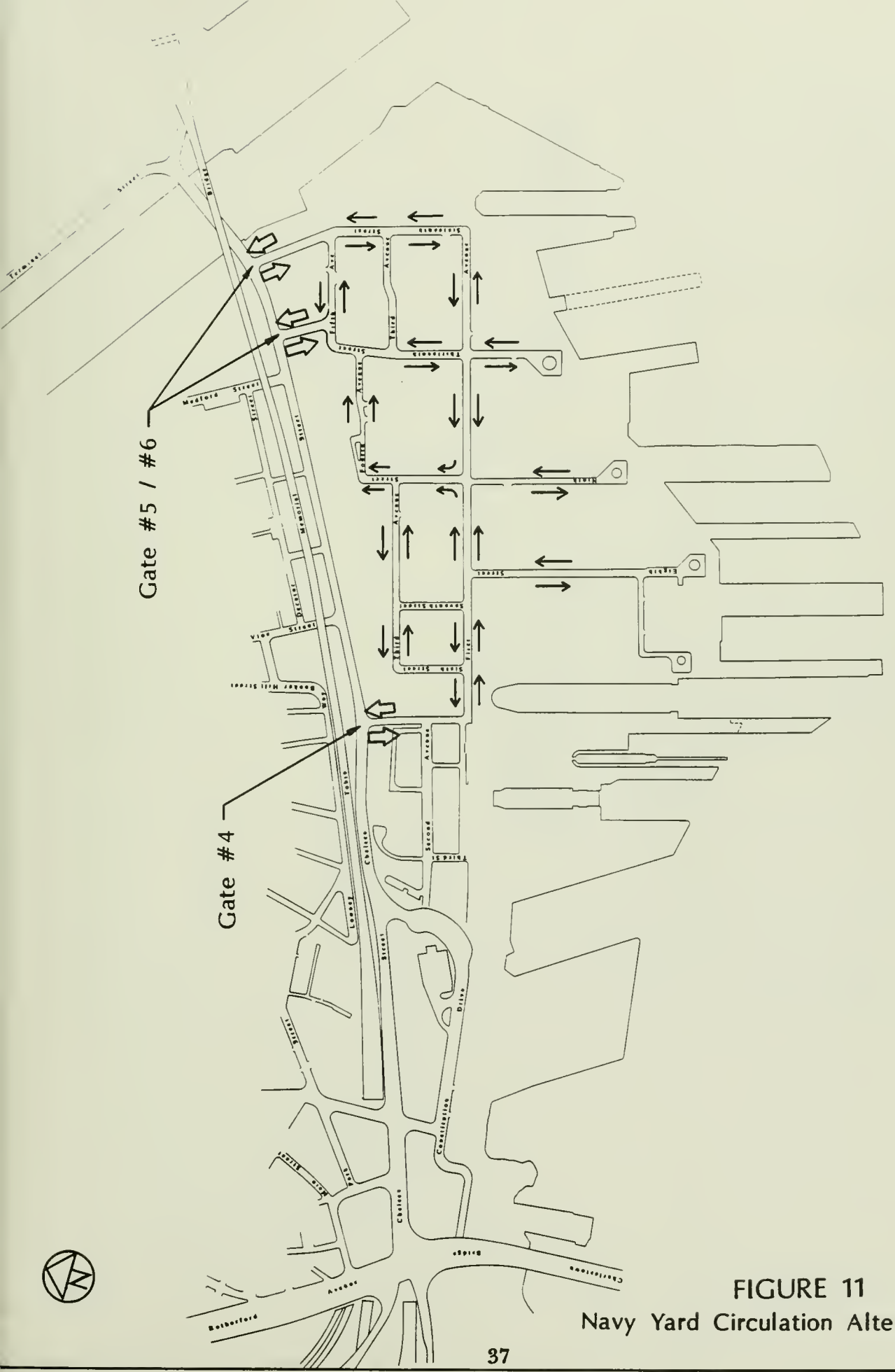


FIGURE 11
Navy Yard Circulation Alternative A

FIGURE 12
Navy Yard Circulation Alternative B

B. MEDFORD STREET BYPASS

Concern has been raised that congestion in the City Square area may divert some Navy Yard traffic to Medford Street as an alternative route for traffic to and from the north. In addition, it is estimated that 18 percent of all Navy Yard traffic will use Medford Street during peak hours as the most direct route to and from the Navy Yard and I-93 North at Sullivan Square and other points in Charlestown, Somerville, and Routes 99 and 28. (This is calculated from Table 9 as 100 percent of I-93 North traffic, 30 percent of Route 99 & 28 traffic, and 30 percent of local traffic.) Because of neighborhood concern over this traffic, as well as existing truck traffic not associated with the Navy Yard, alternatives were explored for developing a parallel roadway using Terminal Street and the railroad right-of-way between the Moran Terminal and Sullivan Square.

A field reconnaissance of the alignment illustrated in Figure 13 was conducted to determine the feasibility of this option. Based on very preliminary information it appears possible to develop a new roadway in two phases from Sullivan Square to Terminal Street utilizing the railroad right-of-way. From Terminal Street the road would connect to the Navy Yard at Gates #5 and #6 via the Little Mystic Bridge and Chelsea Street. A two phased project appears likely because of the narrow right-of-way near Sullivan Square and the difficulty of introducing a new intersection at this location without major changes to other streets entering Sullivan Square.

The Phase I project would begin at Medford and Chappie Streets and proceed along or parallel to the rail tracks to Terminal Street. Medford Street might be terminated in a cul-de-sac at Chappie or aligned in a manner to discourage through traffic. Medford Street would also need to be modified at Chelsea Street to discourage use by traffic exiting from Gates #5 and #6 in the Navy Yard. This could be accomplished by a cul-de-sac on Medford at Chelsea Street or the conversion of Medford to one-way southbound between Decatur and Chelsea Streets.

The Phase II project would complete the bypass road to Sullivan Square and include modifications to Sullivan Square to accommodate the new intersection. This project would likely require additional land acquisition and reconstruction of Sullivan Square.

In order to pursue the Medford Street Bypass, further transportation analysis is warranted to determine possible use of the new alignment and the possible impacts at both City Square and Sullivan Square of the diverted traffic. In addition, right-of-way availability for the rail alignment, impacts on rail operations, and property needs in the vicinity of the Schrafft Center should be investigated. Further study should also be undertaken of the options for the modification of Sullivan Square.

FIGURE 13
Medford Street Bypass Road
Alignment And Access

C. NEW ENGLAND AQUARIUM BUS ACCESS AND STORAGE

On an annual basis nearly 11 percent of the Aquarium's visitors arrive by school and tour buses. Bus volumes tend to peak during the spring when visits by school groups are highest. At peak times in 1995 it is estimated that the Aquarium must accommodate the simultaneous loading and unloading of up to six buses and that a parking area capable of holding nearly 60 buses is needed.

A series of options have been investigated for accommodating Aquarium related bus access, loading and parking. The preferred scheme is illustrated in Figure 14, and involves the following:

- Buses would access the Navy Yard through a realigned Gate #5 or a new Gate #6.
- Buses would travel down Sixteenth Street to a bus loading and turnaround area in front of the Aquarium where passengers would be unloaded.
- Buses would then proceed to exit the Yard using Sixteenth Street and Gates #5 or #6 to Chelsea Street, turn right on Chelsea, cross the Little Mystic Channel to Terminal Street, and enter a surface lot parking area built on the long narrow piece of land between Chelsea Street and the Little Mystic Channel.
- The access pattern would occur in reverse when buses return to the Aquarium from the parking area to pick-up passengers.

VII. PARKING REQUIREMENTS

Parking requirements were forecast for the Master Plan Phase I development for three time periods, corresponding to peak weekday demand during most of the year, peak weekday demand in the summer when parking demand peaks for the Aquarium and the National Park, and peak Saturday demand in the summer when recreation demand is highest. Estimates of demand were then compared to the Master Plan's proposed parking supply to determine average parking conditions in the Navy Yard during the three time periods examined.

A. EXISTING PARKING DEMAND

Parking demand rates were developed for the existing uses in the Yard based on the 1989 calibrated trip rates and density estimates provided by the BRA. These rates were then applied to the existing uses in the Yard and an estimate of peak midday parking accumulation was then made. This estimate indicates that the current uses should generate a demand for approximately 1700 parking spaces at midday during the winter, exclusive of construction activity. (Demand and supply analysis for National Park and Navy employees was excluded since this was assumed to be accommodated within the National Park.) To verify these rates a survey of the Yard was conducted between 11:30 AM and 2:00 PM on January 31, 1990 (Wednesday) by the BRA staff. This survey found a peak accumulation of 1,621 vehicles in all on- and off-street facilities in the Yard. Of this total 150 vehicles were estimated to be associated with construction activities. Thus, the 1989 rates predict peak accumulation

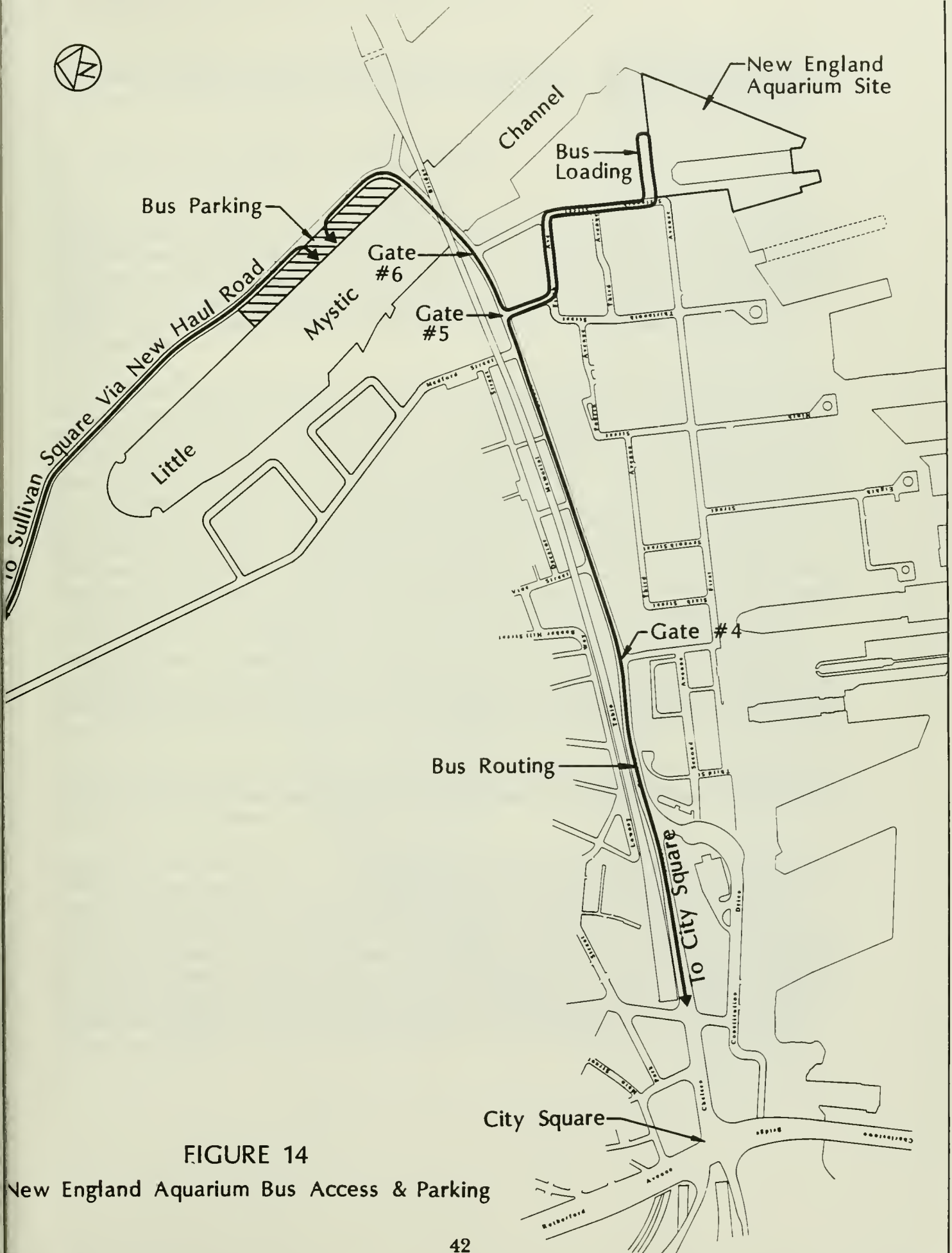


FIGURE 14

New England Aquarium Bus Access & Parking

of 16 percent higher than that observed by this one time count. Because peak demand can vary from day to day, this fit appears reasonable and contains a sufficient margin for error.

B. MASTER PLAN PHASE I PARKING DEMAND

Parking demand estimates for both the Aquarium and the National Park were estimated directly based on forecasts of visitor volume and characteristics. Parking demand estimates for the other uses in the Navy Yard were based on the employee densities, transit use estimates, and average vehicle occupancy estimates used in the traffic forecasting. The 1989 rates were modified for the year 1995 to reflect an increase in the use of the transit shuttles and water shuttles, as well as slightly higher walking and linked trip rates typical of mixed use developments.

For the rehabilitated office space, a rate of 2.39 parking spaces per 1000 square feet of space was developed, assuming an employee density of 4/1000 square feet, 90 percent employee attendance at peak times, 10 percent walk to work by Yard residents, 75 percent auto use by non-Yard residents, 1.11 commuters per auto, and a non-employee parking demand of 0.2 spaces/1000 square feet. For research and development space, a rate of 0.82 parking spaces per 1000 square feet of space was developed, assuming an employee density of 2.2/1000 square feet, 90 percent employee attendance at peak times, 10 per cent walk to work by Yard residents, 45 percent auto use by non-Yard residents, 1.11 commuters per auto, and a non-employee parking demand of 0.1 spaces/1000 square feet. For retail, a figure of 2.00 parking space per 1000 square feet was used to reflect both short and long term demand. The retail rate was not modified from that used for the 1989 estimate. For the hotel, demand was assumed to peak at 1 parking space per room for both long and short term demand. For residential space, a demand figure of 1.24 spaces per unit was used to reflect existing auto ownership by Navy Yard residents. This rate was also the same as that used for 1989. Parking demand for the marina was estimated at 0.13 spaces per slip during weekdays in April, 0.26 spaces per slip during weekdays in August, and 0.46 spaces per slip during August Saturdays.

Tables 14, 15, and 16 summarize the estimates of gross parking demand for the three time periods by individual land use. Also shown are estimates of the peak accumulation of vehicles in the Yard for the three time periods.

Significant potential for joint use of parking spaces exists in the Navy Yard, since the peak parking demand associated with the different uses will occur at different time periods. For example, the hotel and residential demand will peak in the evening when the demand associated with the office and research use will be low. The maximum parking accumulation was calculated using a model developed by the Urban Land Institute (ULI) which estimates the percent of spaces occupied by time of day for each land use category. Figure 15 illustrates graphically the change in parking accumulation by use in the Yard for a typical weekday in August from 6 AM to 12 AM. From this graph it can be seen how the demand by land use varies over the day.

FIGURE 15
Charlestown Navy Yard Weekday Parking Accumulation
August 1995

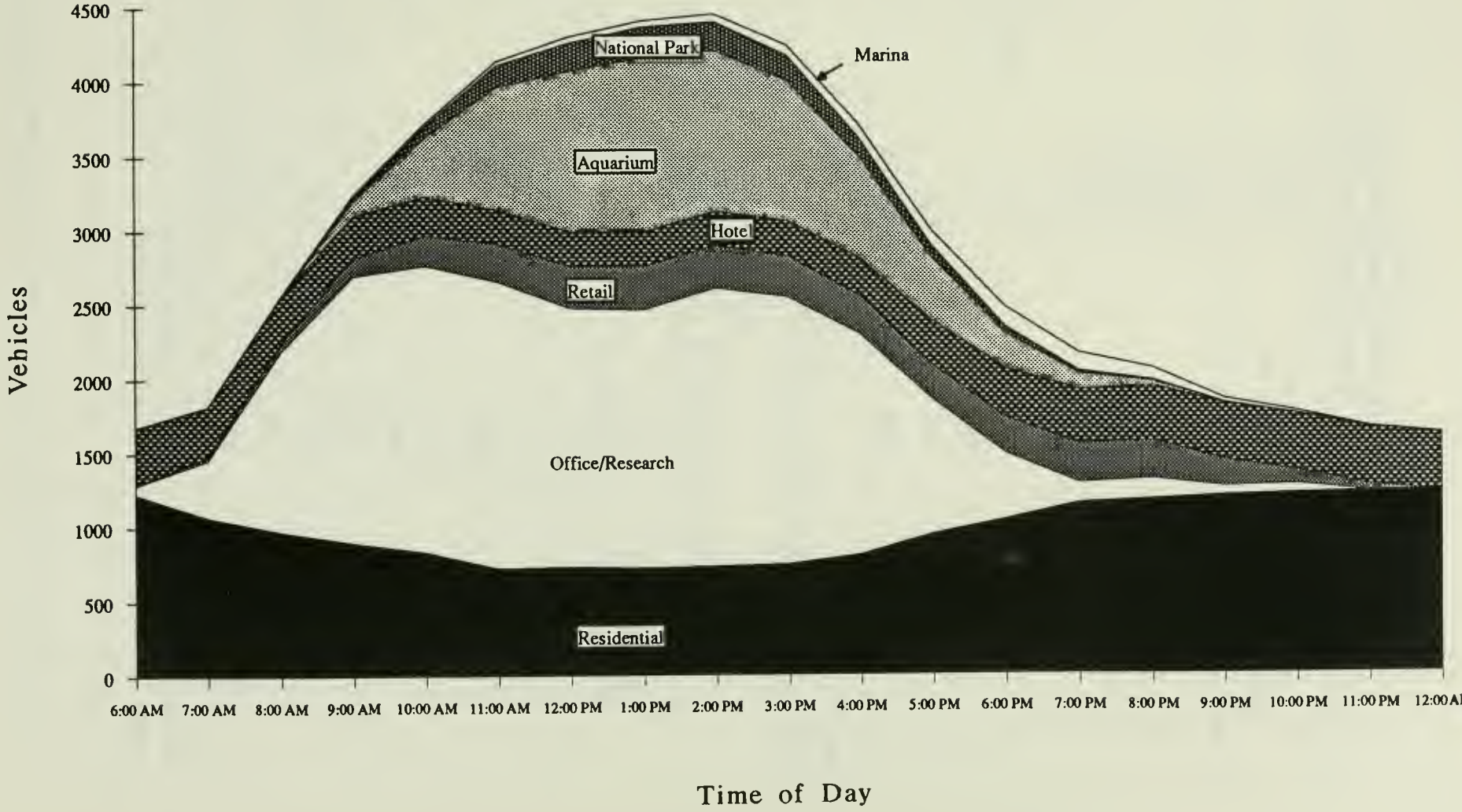


TABLE 14
Master Plan Phase I Development
Average Weekday Parking Demand, April 1995

Land Use	Square Footage	Parking Demand Rate	Peak Parking Demand (spaces)
Office	403,000	2.39	963
Research	1,180,000	0.82	970
Retail	147,000	2.00	294
Hotel (per room)	390	1.00	390
Residential (per unit)	991	1.24	1,229
Marina (per boat slip)	525	0.13	68
National Park*	N/A	N/A	80
N.E. Aquarium	275,000	N/A	683
		Gross Demand	4,677 spaces
		Maximum Vehicle Accumulation	3,855 spaces

TABLE 15
Master Plan Phase I Development
Peak Summer Weekday Parking Demand, August 1995

Land Use	Square Footage	Parking Demand Rate	Peak Parking Demand (spaces)
Office	403,000	2.39	963
Research	1,180,000	0.82	970
Retail	147,000	2.00	294
Hotel (per room)	390	1.00	390
Residential (per unit)	991	1.24	1,229
Marina (per boat slip)	525	0.26	137
National Park*	N/A	N/A	211
N.E. Aquarium	275,000	N/A	1,171
		Gross Demand	5,365 spaces
		Maximum Vehicle Accumulation	4,406 spaces

* Estimate includes only visitor parking demand. Employee demand was assumed to be accommodated within the NPS site.

TABLE 16
Master Plan Phase I Development
Peak Summer Saturday Parking Demand
August 1995

Land Use	Square Footage	Parking Demand Rate	Peak Parking Demand (spaces)
Office	403,000	0.30	121
Research	1,180,000	0.10	118
Retail	147,000	2.00	294
Hotel (per room)	390	1.00	390
Residential (per unit)	991	1.24	1,229
Marina (per boat slip)	525	0.46	242
National Park*	N/A	N/A	328
N.E. Aquarium	275,000	N/A	1,819
		Gross Demand	4,540 spaces
		Maximum Vehicle Accumulation	3,611 spaces

* Estimate includes only visitor parking demand. Employee demand was assumed to be accommodated within the NPS site.

The results of the analysis shown in Table 14 indicate that during most of the year parking demand will peak at approximately 3,860 vehicles on an average weekday. During the peak summer months of July and August when visitation to the New England Aquarium and National Park will peak, average weekday accumulation will rise by 550 vehicles to 4,410, as shown in Table 15. Finally, Table 16 shows that on Saturdays during the summer months when visitor parking demand will be the highest a total of just over 3,610 vehicles will need to find parking in the Yard at the times of peak accumulation.

C. 1995 PARKING SUPPLY

The Phase I Master Plan projects a total of 4,510 parking spaces in the Navy Yard by the year 1995. Of these spaces 448 would be deeded for exclusive use by residential condominiums and the marina. Of the balance, 290 spaces would be on-street and 3,772 would be off-street and available for general use by workers and visitors to the Navy Yard. As a result a total supply of 4,062 commercial spaces would be available to meet peak daytime parking needs. Table 17 compares these supply figures against the projected peak accumulations for the three time periods analyzed. From this table it can be seen that both the average weekday and peak summer Saturday demand can be comfortably accommodated at utilization rates that peak at 88 percent.

During peak summer weekdays, however, a utilization rate of 100 percent would be needed to meet the projected peak accumulation. Since parking utilization beyond 95 percent is very difficult to achieve, up to an additional 205 parking spaces will be needed on weekdays during the peak summer periods of July and August. The construction of these spaces in a garage in the Yard is economically questionable since they would be used for such a short period of the year. As an alternative combinations of the following strategies are recommended to achieve a reserve of 200 spaces for use by peak summer overflow visitors to the Aquarium and the National Park:

- The proposed bus parking area along the Little Mystic will not be fully needed for buses in the summer, since school bus visitation to the Aquarium is quite low in July and August. If fully converted the lot could accommodate 200-250 cars, depending on the amount of space reserved for buses.

- Valet parking could be instituted on peak summer days in a number of the garage facilities, including the existing Building #199, the proposed hotel garage and the other garages to be built in the Yard's End area. Depending on the number of facilities adopting valet parking an additional 200 spaces should not be difficult to achieve.

TABLE 17
1995 Parking Conditions at Peak Accumulation
Master Plan Phase I

	Average Weekday Peak (Spaces)	Summer Weekday Peak (Spaces)	Summer Saturday Peak (Spaces)
Total Supply	4,510	4,510	4,510
Deeded Parking Supply	448	448	448
Deeded Parking Demand	273	342	447
Off-Street Commercial Supply	3,772	3,772	3,772
On-Street Supply	290	290	290
Total Public Supply	4,062	4,062	4,062
Total Public Demand	3,582	4,064	3,164
Surplus (Deficit)	480	(2)	898
Percent Utilization	88%	100%	78%
Additional Parking Required to Maintain 95% Utilization	None	205	None

VIII. PUBLIC TRANSPORTATION

A key element of an effective transportation plan for the Navy Yard is improved public transportation. The current major employers in the Navy Yard have achieved workforce public transportation use of 45 percent as a result of aggressive shuttle bus and ridesharing programs and the water shuttle service to Long Wharf. While these programs should be continued, further development of the Navy Yard will require expanded transit services. In addition to transit service required for day-to-day commuter needs, the Aquarium is projecting that over 25 percent of its visitors will arrive by means other than automobile. The transit services projected to serve the Master Plan Phase I development of the Navy Yard include the following:

1. Expanded Shuttle Bus Services

A public or private bus shuttle service should be developed with connections to the MBTA rail system at North Station (Commuter rail, Orange and Green Lines), Community College or Sullivan Square (Orange Line), Lechmere (Green Line) and Kendall or Charles (Red Line). This system should focus on serving the high density employment centers in the Yard's End area, and could operate in and out of the realigned Gate #5 or a new Gate #6. The connections could be achieved by regularly scheduled MBTA service or by private service similar to that operated by the World Trade Center in the South Boston Piers area and MASCO in the Longwood Medical area.

2. Internal Transit Shuttle

A shuttle system may also be desireable within the Navy Yard during the tourist season, running between the Aquarium and parking areas at Yard's End and the National Park Service property at the western end of the Yard. This could be accomplished with either small buses or a tram system oriented toward Aquarium and National Park visitors. Such a shuttle could gain better use of the existing Building #199 garage and the new parking facilities to be built in the Yard's End area. The shuttle or tram would also reduce the need for auto circulation by visitors among attractions in the Navy Yard.

3. Water Transportation

The current water shuttle service between Long Wharf and the Navy Yard will need to be expanded to provide additional connections. A study recently completed on the potential of Inner Harbor water transportation identifies the potential for a number of new services to the Charlestown Navy Yard by the year 2010.[14] These routes are illustrated in Figure 16 and include the following:

---

[14] "Boston Inner Harbor Water Transportation Study;" Massport, EOTC, Legislative Special Committee on Marine Transit, MBTA, and MDPW; TAMS Consultants, Inc. and Charles Norris; October 1989.

- Expansion of the existing service from Pier 4 to Long Wharf to include a new stop near Russia Wharf.

- A new route connecting North Station to the Yard's End area and then continuing on to Logan Airport.

- A new route from the Yard's End area to Russia Wharf near South Station and the financial district.

- A high capacity shuttle between Central Wharf and the Aquarium at Drydock #5 operated during the peak summer months as a visitor attraction element of the Aquarium's program. Use of vessels capable of accommodating 149 passengers and service every fifteen minutes will be needed both to handle demand and provide an attractive alternative to driving between tourist destinations in the downtown and Charlestown.

4. Transportation Management Association

A Transportation Management Association should be formed including participation by the New England Aquarium, private developers in the Yard, major tenants in the Yard, the National Park Service, Charlestown community representatives, the Boston Redevelopment Authority, the Boston Transportation Department, and the MBTA. This organization should be responsible for the management of all transportation services and public parking resources in the Yard, the setting of goals for levels of transit use and ridesharing, the monitoring of goals achievement, and the development of additional improvements as required to meet goals. Transportation Management Associations have been included in the Transportation Access Plans for several large scale developments in Boston, such as the Olmsted Plaza and the Prudential Center developments.

IX. PHASE II DEVELOPMENT

Beyond the year 1995, a second phase of development is proposed in the Yard which includes biomedical research space, cultural uses, and a minimum of 100 units of affordable housing. In addition, a Special Study are is defined along Ninth Street to include Buildings 108, 150, 39A and 40A. Specific uses within this area will be defined after additional detailed evaluation of alternatives.

For purposes of the transportation analysis, a residential build-out was evaluated for the Special Study are in conjunction with the second phase of Navy Yard development. Accordingly, the following uses are presumed to be added between 1995 and the year 2000:

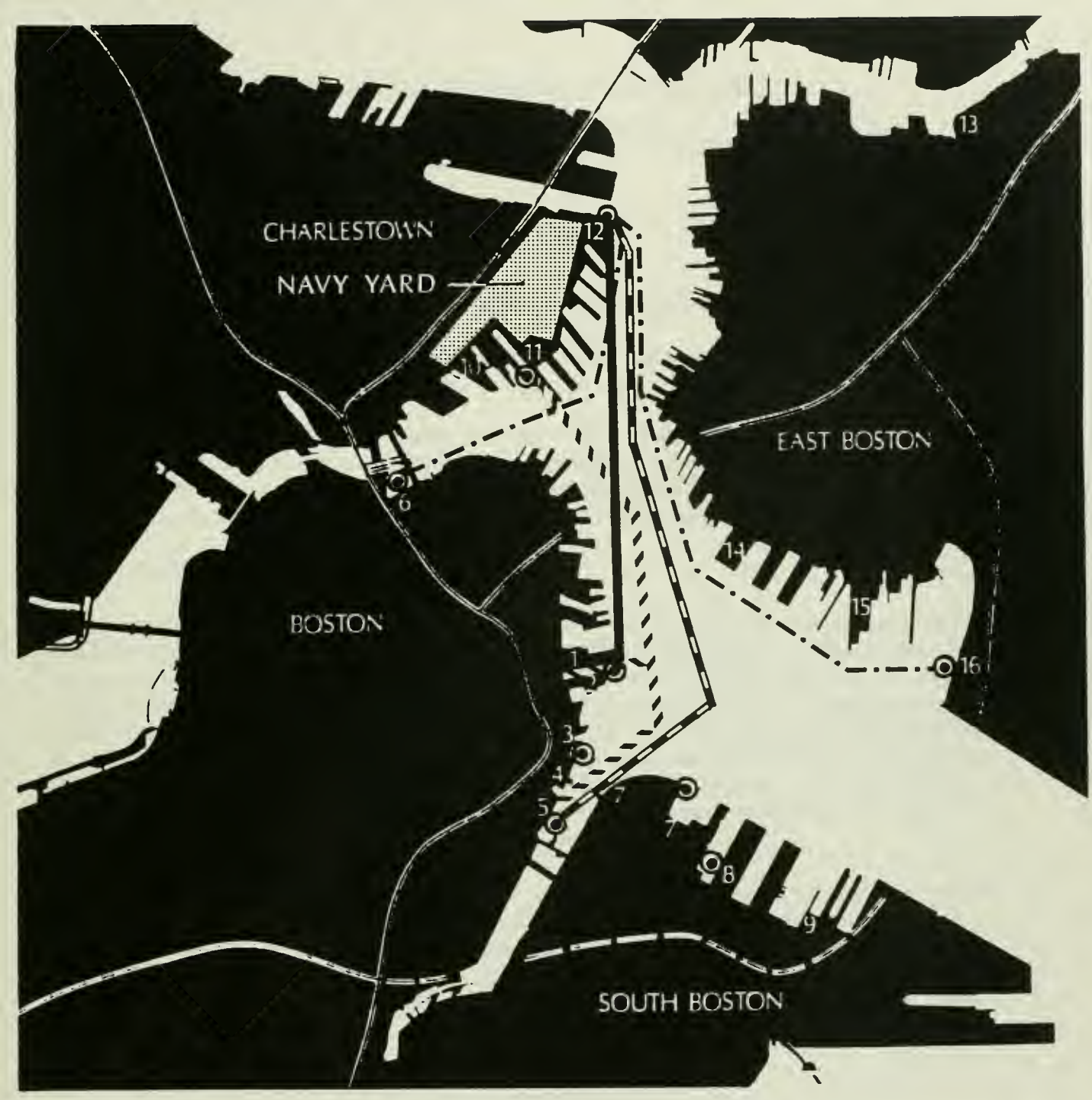


FIGURE 16

Charlestown Navy Yard Year 2000 Water Shuttle Routes

Pier 4 – Long Wharf – Russia Wharf (Existing to be expanded)

North Station – Yard's End – Logan Airport

Yard's End – Russia Wharf

Aquarium – Central Wharf (Summer only)

- o 24,000 square feet of retail space, for a total of 171,000 square feet;
- o 550,000 square feet of additional research and development space, for a total of 1,730,000 square feet;
- o 398,000 square feet of housing in 309 units, for a total of 1,699,400 square feet and 1,300 housing units;
- o 150,000 square feet of nursing home to accommodate 200 beds; and
- o 195,000 square feet of cultural exhibit space, the majority of which would be a museum occupying the Rope Walk structure.

The total development by the year 2000 is summarized in Table 18, and results in a total of 4,973,000 square feet of space. A transportation analysis of the Phase II program was undertaken using the methodology and assumptions described in Section IV. The results of this analysis are summarized in the following sections and accompanying tables.

A. TRIP GENERATION

Trip generation estimates were developed for the year 2000 for both the average weekday condition and the peak summer weekday condition. The methodology and assumptions used are described in the earlier Sections IV.A and IV.B. Tables 18 and 19 summarize the results of this analysis, together with the year 2000 vehicle trip generation rates. Comparing these tables to the earlier estimates for the year 1995, it can be seen that average weekday vehicle trip volumes will increase by approximately 1,260 trips between 1995 and the year 2000, and peak summer weekday trips will go up by roughly 1,250 during the same time frame. PM peak volumes will also increase. During an average weekday, peak hour volumes will increase by about 150 trips between 1995 and the year 2000.

A key factor which results in lower growth than might be expected is the reduction in travel to the New England Aquarium between 1995 and the year 2000. Experience at the new aquarium in Monterey, California indicates that visitation will peak in the early years and then drop back to a more steady volume. In the case of the Charlestown facility, the Aquarium estimates that annual visitation in the year 2000 will be roughly 14 percent below early year attendance figures.

TABLE 18
April 2000 Total Vehicle Trips
Phase II Master Plan

Land Use	Square Footage	Daily Rate	Total Daily Trips	AM Peak Trips	PM Peak Trips
Rehab Office	403,000	4.9	1,984	270	209
Research	1,730,000	1.9	3,359	457	354
Retail	171,000	11.1	1,904	27	117
Hotel	350,000	5.9	2,059	124	124
Marina (slips)	525	0.6	335	6	10
Residential	1,699,400	3.4	5,732	298	377
Nursing Home	150,000	1.6	238	4	10
Cultural Space	195,000	0.9	169	11	56
National Park	N/A	N/A	720	25	61
Aquarium	275,000	N/A	2,029	46	229
TOTALS	4,973,400		18,529	1,267	1,546

TABLE 19
August 2000 Total Vehicle Trips
Phase II Master Plan

Land Use	Square Footage	Daily Rate	Total Daily Trips	AM Peak Trips	PM Peak Trips
Rehab Office	403,000	4.9	1,984	270	209
Research	1,730,000	1.9	3,359	457	354
Retail	171,000	11.1	1,904	27	117
Hotel	350,000	5.9	2,059	124	124
Marina (slips)	525	1.2	628	11	19
Residential	1,699,400	3.4	5,732	298	377
Nursing Home	150,000	1.6	238	4	10
Cultural Space	195,000	1.2	228	11	59
National Park	N/A	N/A	2,131	25	181
Aquarium	275,000	N/A	3,832	46	412
TOTALS	4,973,400		22,095	1,272	1,861

B. TRAFFIC ANALYSIS

A level of service analysis of the key area intersections was undertaken for the Master Plan Phase II development in the year 2000. The methodology and assumptions are described in the earlier Section V. The following sections describe the results of the analysis for City Square, and the key intersections along Chelsea Street.

1. City Square Intersection

Since the 1995 analysis indicated that City Square will not operate at an acceptable level of service unless improvements of the type recommended by the Boston Transportation Department are undertaken, only this design was evaluated in the year 2000. Figures 17 and 18 illustrate the projected AM and PM peak hour turn movements at City Square for a typical weekday in August of the year 2000. Findings of the City Square Level of Service analysis are summarized in Table 20. From the results it can be seen that with the proposed improvements the intersection is projected to operate at an acceptable Level of Service "D" for both time periods in the year 2000.

TABLE 20
City Square Signalized Intersection Analysis Year 2000

Alternative	LOS	Delay (sec.)
DPW Design		
AM Peak	Not Analyzed	Not Analyzed
PM Peak	Not Analyzed	Not Analyzed
VHB Design		
AM Peak	D*	32
PM Peak	D*	37

* At least one move is at level of service "E"

2. Chelsea Street Intersections

The intersections of Chelsea Street with Fifth Street (Gate #4), Medford Street, Thirteenth Street (Gate #5), and Sixteenth Street (Gate #6) were analyzed under the two scenarios of improved Yard access, described in Section V.B. These options include the widening and/or realignment of Gate #5 and the construction of a new Gate #6.

Figures 17 and 18 illustrate the projected year 2000 volumes for the option which assumes a widened Gate #5 in the year 2000. The results of the intersection level of service analysis under this alternative improvement are summarized in Table 21. Conclusions of the analysis are that all three intersections will operate at an acceptable level of service during the AM and PM peak hours of a typical August weekday when traffic volumes are highest.

FIGURE 17

Year 2000 AM Peak Hour Build Volumes

Widened Gate #5

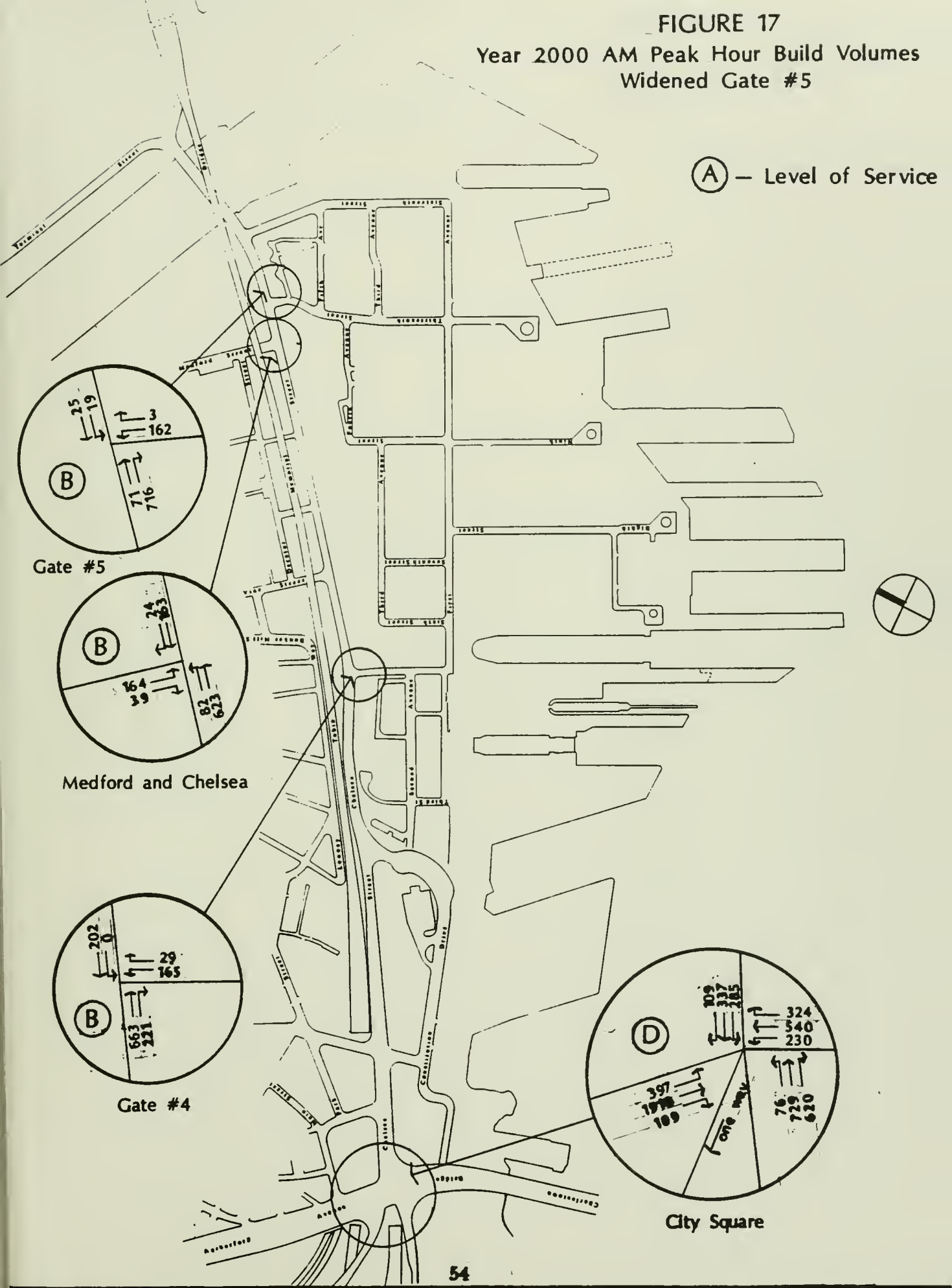


FIGURE 18

Year 2000 PM Peak Hour Build Volumes
Widened Gate #5

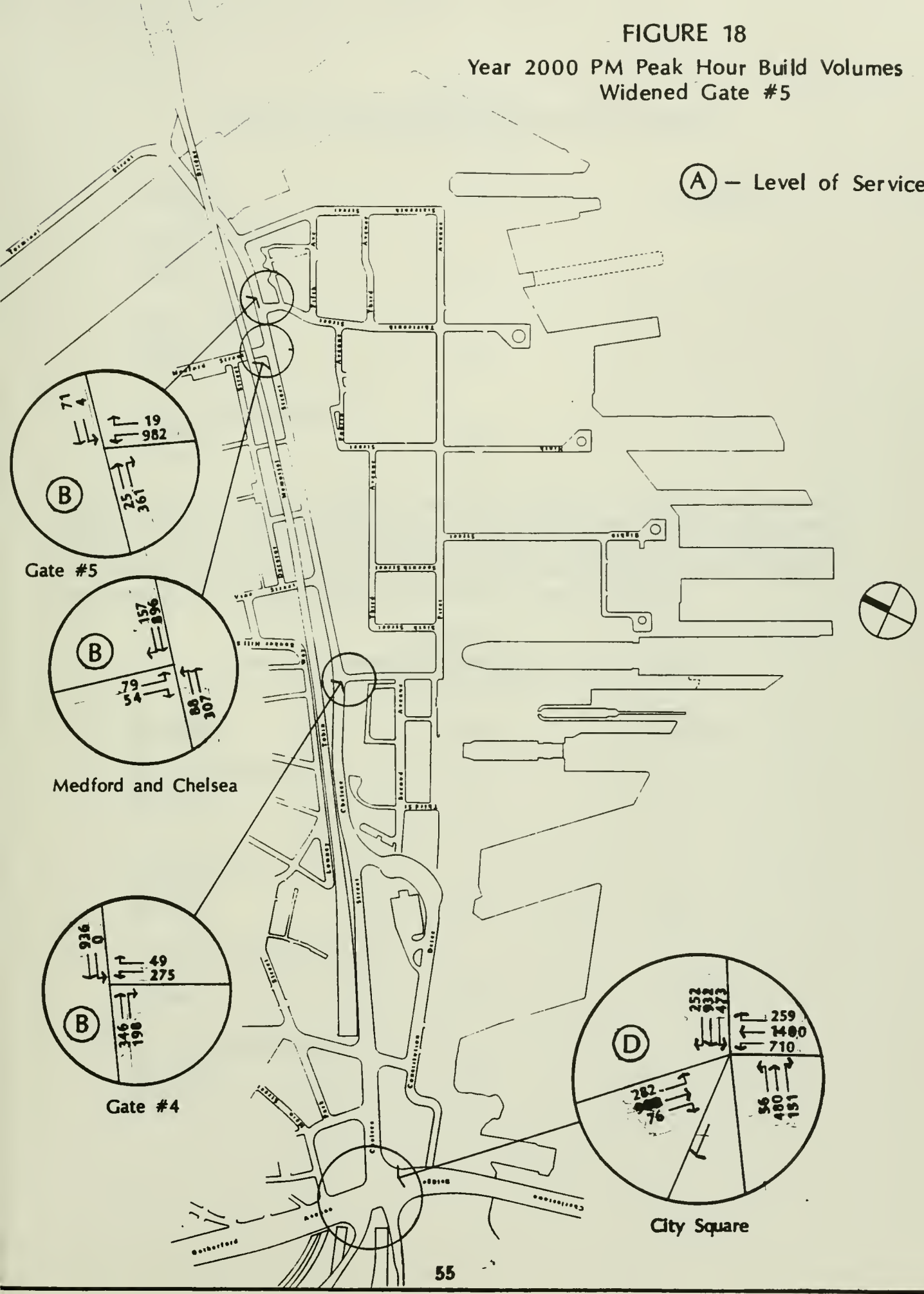


TABLE 21
Chelsea Street Signalized Intersection Analysis Year 2000
Widened Gate #5

Intersection	LOS	Delay (sec.)
Gate 4 (Fifth Street)		
AM Peak	B	7
PM Peak	B	9
Medford Street		
AM Peak	B	9
PM Peak	B	6
Gate 5 (Thirteenth Street)		
AM Peak	B	8
PM Peak	B	13

Figures 19 and 20 illustrate the projected year 2000 volumes for the option which assumes a new Gate #6 in the year 2000. The results of the intersection level of service analysis under this alternative improvement are summarized in Table 22. Conclusions of the analysis are that all four intersections will operate at an acceptable level of service during the AM and PM peak hours of a typical August weekday when traffic volumes are highest.

TABLE 22
Chelsea Street Signalized Intersection Analysis Year 2000
New Gate #6

Intersection	LOS	Delay (sec.)
Gate 4 (Fifth Street)		
AM Peak	B	7
PM Peak	B	9
Medford Street		
AM Peak	B	9
PM Peak	B	6
Gate 5 (Thirteenth Street)		
AM Peak	A	2
PM Peak	A	1
Gate 6 (Sixteenth Street)		
AM Peak	B	7
PM Peak	B	6

FIGURE 19

Year 2000 AM Peak Hour Build Volumes
New Gate #6

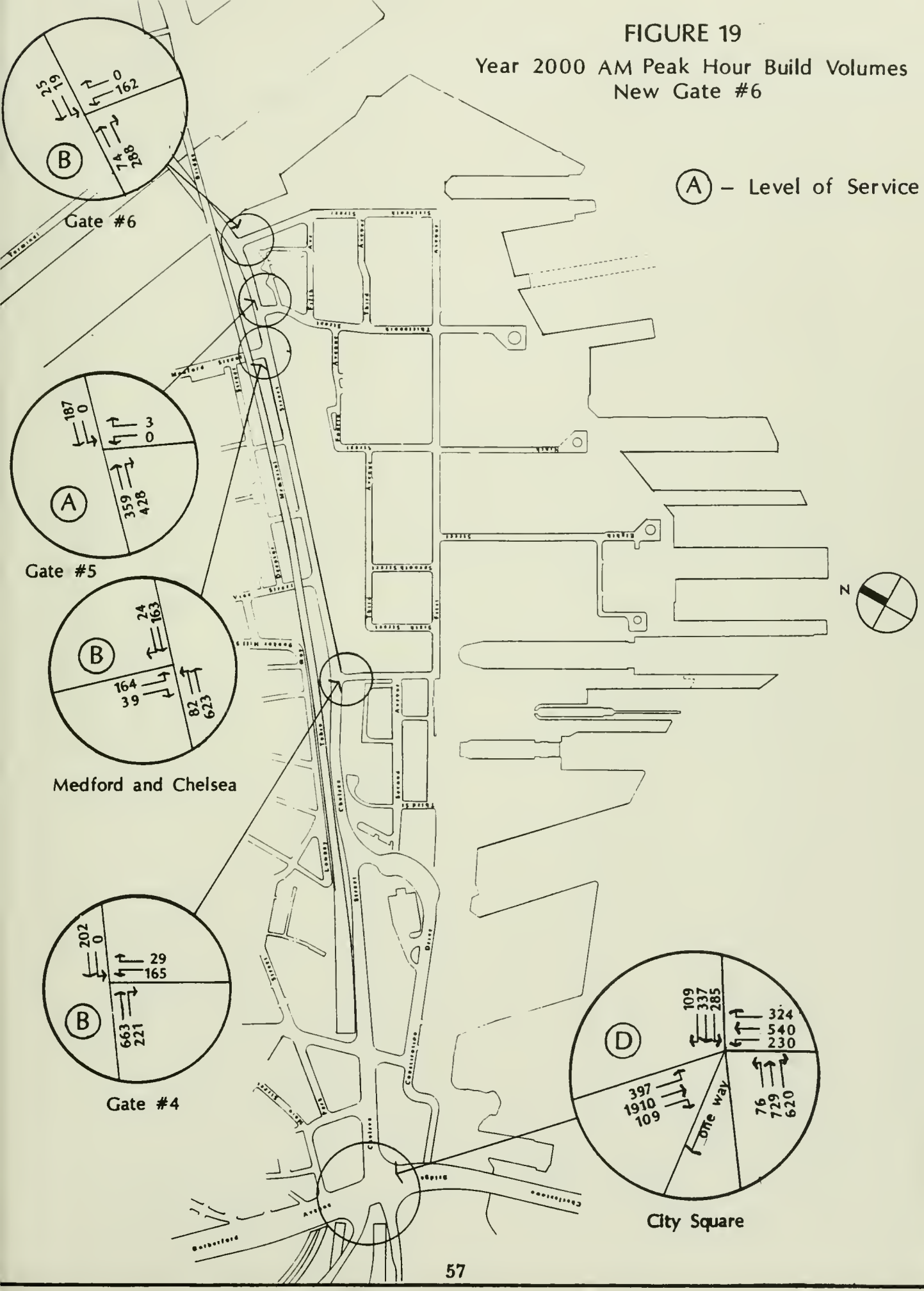
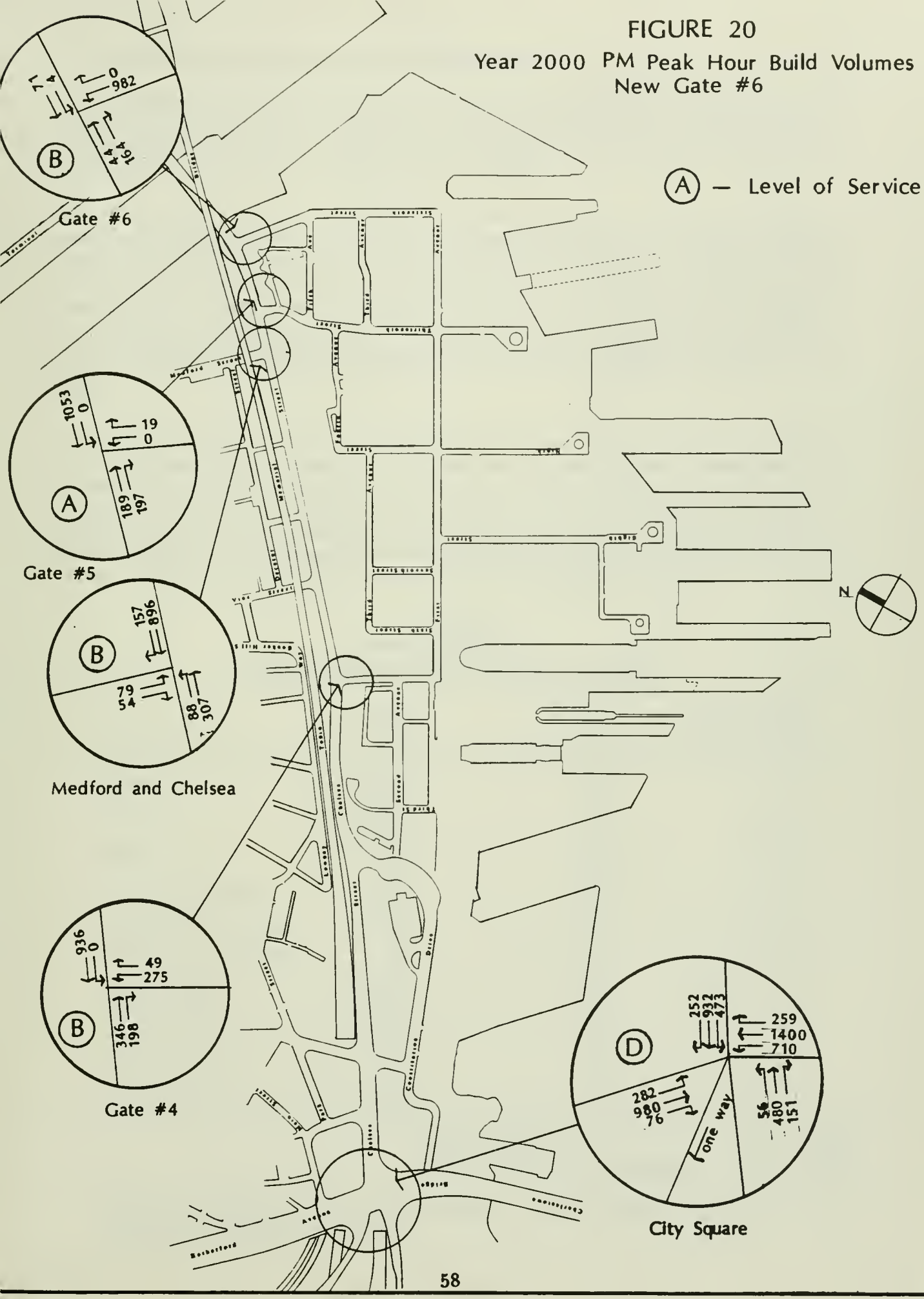


FIGURE 20

Year 2000 PM Peak Hour Build Volumes
New Gate #6



C. MASTER PLAN PHASE II YEAR 2000 PARKING ANALYSIS

Parking demand estimates for the Phase II development in the year 2000 were made using the methodologies and assumptions described for the Phase I analysis in Section VII. Minor modifications were made to the demand rates for employment generating uses to reflect the projected increase in transit and walking for the year 2000.

Tables 23, 24, and 25 summarize the estimates of gross parking demand for the three time periods by individual land use. Also shown are estimates of the peak accumulation of vehicles in the Yard for the three time periods. Significant potential for joint use of parking spaces exists in the Navy Yard, since the peak parking demand associated with the different uses will occur at different time periods. For example, the hotel and residential demand will peak in the evening when the demand associated with the office and research use will be low. The maximum parking accumulation was calculated using a model developed by the Urban Land Institute which estimates the percent of spaces occupied by time of day for each land use category.

The results of the analysis shown in Table 23 indicate that during most of the year parking demand will peak at approximately 4,420 vehicles on an average weekday. During the peak summer months of July and August when visitation to the New England Aquarium and National Park will peak, average weekday accumulation will rise by 520 vehicles to 4,940 parking spaces, as shown in Table 24. Finally, Table 25 shows that on Saturdays during the summer months when visitor parking demand will be the highest a total of just over 3,730 vehicles will need to find parking in the Yard at the times of peak accumulation.

TABLE 23
Master Plan Phase II
Average Weekday Parking Demand, April 2000

Land Use	Square Footage	Parking Demand Rate	Peak Parking Demand (spaces)
Office	403,000	2.24	904
Research	1,730,000	0.82	1,423
Retail	171,000	2.00	342
Hotel (per room)	390	1.00	390
Residential (per unit)	1,300	1.24	1,612
Marina (per boat slip)	525	0.13	68
Cultural Space	195,000	0.22	44
Nursing Home	150,000	0.13	20
National Park*	N/A	N/A	93
N.E. Aquarium	275,000	N/A	585
		Gross Demand	5,481 spaces
		Maximum Vehicle Accumulation	4,415 spaces

* Estimate includes only visitor parking demand. Employee demand was assumed to be accommodated within the NPS site.

TABLE 24
Master Plan Phase II
Peak Summer Weekday Parking Demand, August 2000

Land Use	Square Footage	Parking Demand Rate	Peak Parking Demand (spaces)
Office	403,000	2.24	904
Research	1,730,000	0.82	1,423
Retail	171,000	2.00	342
Hotel (per room)	390	1.00	390
Residential (per unit)	1,300	1.24	1,612
Marina (per boat slip)	525	0.26	137
Cultural Space	195,000	0.33	64
Nursing Home	150,000	0.13	20
National Park*	N/A	N/A	245
N.E. Aquarium	275,000	N/A	1,004
		Gross Demand	6,140 spaces
		Maximum Vehicle Accumulation	4,942 spaces

TABLE 25
Master Plan Phase II
Peak Summer Saturday Demand, August 2000

Land Use	Square Footage	Parking Demand Rate	Peak Parking Demand (spaces)
Office	403,000	0.30	121
Research	1,730,000	0.10	173
Retail	171,000	2.00	342
Hotel (per room)	390	1.00	390
Residential (per unit)	1,300	1.24	1,612
Marina (per boat slip)	525	0.46	242
Cultural Space	195,000	0.44	86
Nursing Home	150,000	0.13	20
National Park*	N/A	N/A	380
N.E. Aquarium	275,000	N/A	1,559
		Gross Demand	4,924 spaces
		Maximum Vehicle Accumulation	3,727 spaces

* Estimate includes only visitor parking demand. Employee demand was assumed to be accommodated within the NPS site.

The Phase II Master Plan projects a total of 4,850 parking spaces in the Navy Yard by the year 2000. Of these spaces 558 would be deeded for exclusive use by residential condominiums and the marina. Of the balance, 290 spaces would be on-street and 4,002 would be off-street and available for general use by workers and visitors to the Navy Yard. As a result a total supply of 4,292 spaces would be available to meet all peak daytime parking needs. Table 26 compares these supply figures against the projected peak accumulations for the three time periods analyzed.

TABLE 26
2000 Parking Conditions at Peak Accumulation, Master Plan Phase II

	Average Weekday Peak (Spaces)	Summer Weekday Peak (Spaces)	Summer Saturday Peak (Spaces)
Total Supply	4,850	4,850	4,850
Deeded Parking Supply	558	558	558
Deeded Parking Demand	339	408	513
Off-Street Commercial Supply	4,002	4,002	4,002
On-Street Supply	290	290	290
Total Public Supply	4,292	4,292	4,292
Total Public Demand	4,076	4,534	3,214
Surplus (Deficit)	216	(242)	1,078
Percent Utilization	95%	106%	75%
Additional Parking Required to Maintain 95% Utilization	None	457	None

During average weekdays throughout most of the year and on peak summer Saturdays the proposed total supply of 4,850 spaces will be adequate to meet peak accumulations at utilization rates at or below 95 percent. During the peak summer weekdays an additional 460 spaces will be needed to meet the peak parking needs of the Aquarium and the National Park. The construction of these spaces in a garage in the Yard is economically questionable since they would be used for such a short period of the year. As an alternative combinations of the following strategies are recommended to achieve a reserve of up to 460 spaces for use by peak summer overflow visitors to the Aquarium and the National Park:

- The proposed bus parking area along the Little Mystic will not be fully needed for buses in the summer, since school bus visitation to the Aquarium is quite low in July and August. If fully converted the lot could accommodate 200-250 cars, depending on the amount of space reserved for buses.

- Valet parking could be instituted on peak summer days in a number of the garage facilities, including the existing Building #199, the proposed hotel garage and the other

garages to be built in the Yard's End area. Depending on the number of facilities adopting valet parking an additional 250-300 vehicles should not be difficult to achieve.

- Remote parking sites connected to the Aquarium by a shuttle bus using excess parking available during the summertime in locations such as the Bunker Hill Community College should be explored.

6941 38

BOSTON PUBLIC LIBRARY
3 9999 06314 411 5